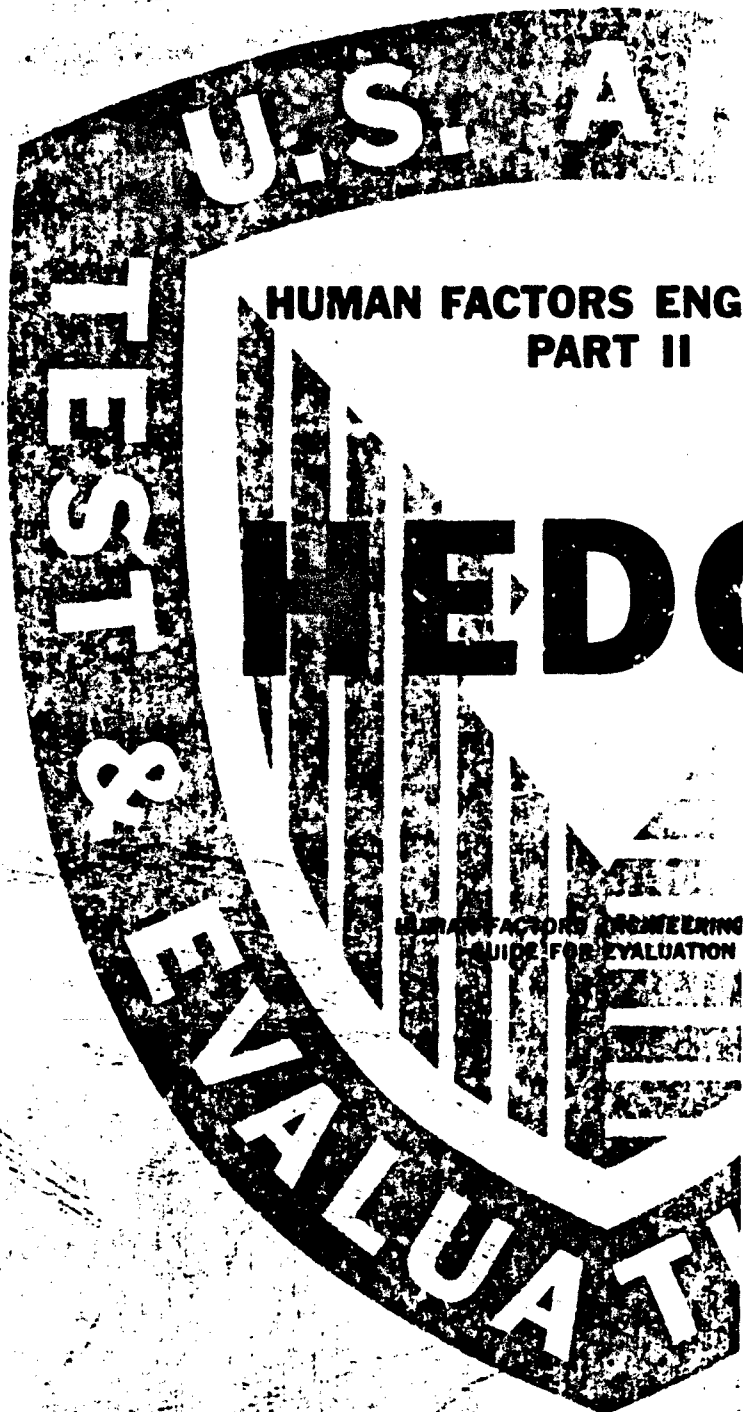


DRSTE-RP-702-100  
Test Operations Procedure 1-2-610  
AD No.

AD A140391

20000803043

Reproduced From  
Best Available Copy

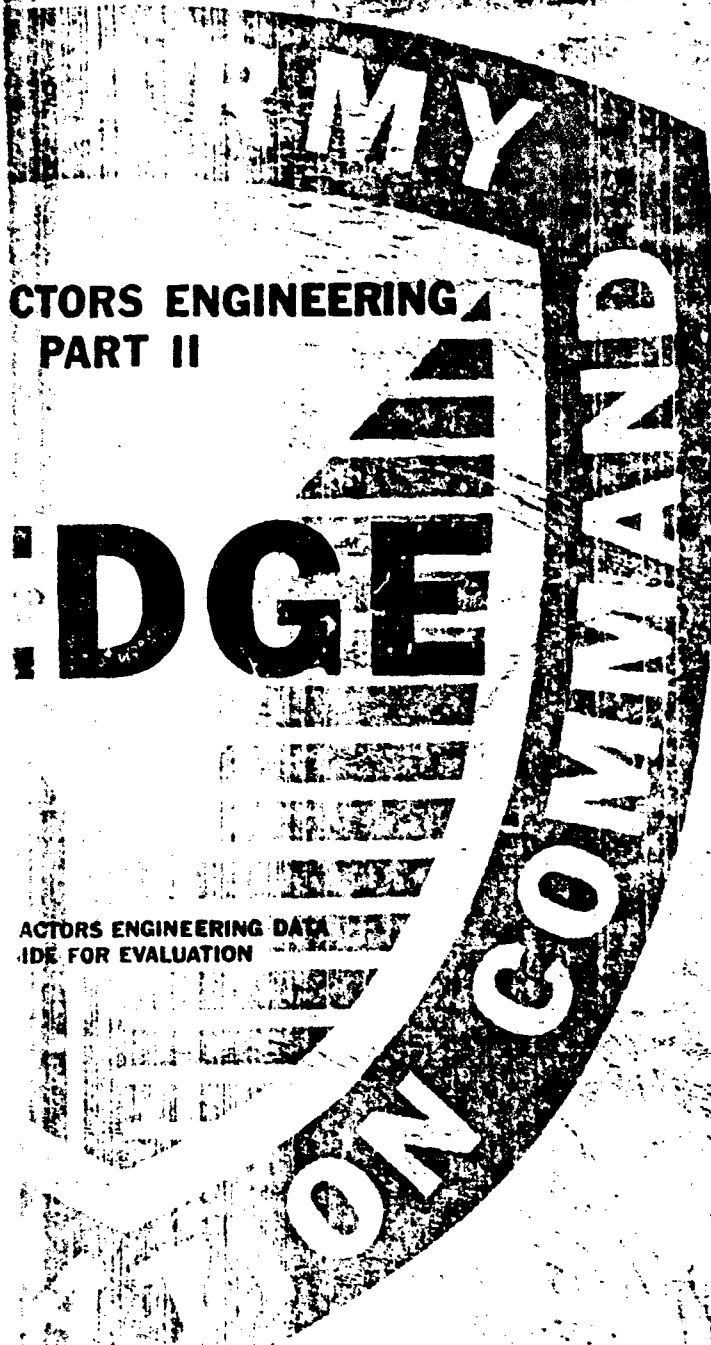


Approved for public release; distribution



(3)

30 November 1983



CTORS ENGINEERING  
PART II

ACTORS ENGINEERING DATA  
IDE FOR EVALUATION

DTIC  
ELECTE  
S APR 20 1984 D

Public release; distribution unlimited.

84 04 13 144



## **REPRODUCTION QUALITY NOTICE**

**This document is the best quality available. The copy furnished to DTIC contained pages that may have the following quality problems:**

- **Pages smaller or larger than normal.**
- **Pages with background color or light colored printing.**
- **Pages with small type or poor printing; and or**
- **Pages with continuous tone material or color photographs.**

**Due to various output media available these conditions may or may not cause poor legibility in the microfiche or hardcopy output you receive.**

☐

**If this block is checked, the copy furnished to DTIC contained pages with color printing, that when reproduced in Black and White, may change detail of the original copy.**



# TABLE OF CONTENTS

|  |    |
|--|----|
| HOW TO USE HEDGE   | 2  |
| THE INDEX  | 4  |
| DEFINITIONS  | 4  |
| OPERABILITY  |    |
| I. <u>Vehicles</u>   |    |
| A. Maneuvering   | 6  |
| B. Air   | 8  |
| C. Non-Maneuvering   | 10 |
| II. <u>Weapons</u>   |    |
| A. Individual  | 12 |
| B. Crew Served   | 14 |
| III. <u>Material Handlers</u>                                    |    |
| A. Man-Operated  | 16 |
| B. Man-Monitored   | 18 |
| IV. <u>Electronics/Signals</u>                                   |    |
| A. Sensors   | 20 |
| B. Information/Command-Control Systems                           | 22 |
| V. <u>Operational Support</u>                                    |    |
| A. Maintenance & Repair Equipment                                | 24 |
| B. Material Production & Environment Control                     | 26 |
| VI. <u>Troop Support Equipment</u>                               |    |
| A. Consumables   | 28 |
| MAINTAINABILITY  |    |
| I. <u>Vehicles</u>   | 30 |
| II. <u>Weapons</u>   | 32 |
| III. <u>Material Handlers</u>                                    | 34 |
| IV. <u>Electronics/Signals</u>                                   | 36 |
| V. <u>Operational Support</u>                                    | 38 |
| TRANSPORTABILITY   | 40 |
| PORTABILITY/USABILITY (Includes Clothing and Personal Equipment) | 42 |
| ERECTABILITY   | 44 |
| HABITABILITY   | 46 |
| FIGURES  | 48 |

The criteria herein reflects that in effect on the date of this document. Test requirements and criteria referred to as Design Requirements are contained in the current issue of MIL-STD-1472 which shall have precedence in case of conflict



### STEP 1

Enter the Index

| Test Functions    |  |
|-------------------|--|
| Test Item Classes |  |
|                   |  |
|                   |  |
|                   |  |
|                   |  |
|                   |  |
|                   |  |
|                   |  |
|                   |  |
|                   |  |

THE INDEX

### STEP 2

Identify Use Conditions and Tasks

| Test Item Function Class & Subclass |  |
|-------------------------------------|--|
| Use Conditions                      |  |
| Task Categories                     |  |
| Purposes                            |  |
| Man/Item Tasks                      |  |
|                                     |  |
|                                     |  |
|                                     |  |
|                                     |  |
|                                     |  |

MAN/ITEM TASK SHEET

### STEP 3

Identify relevant Test Item Components & Human Factors Considerations

| Test Item Components         |  |
|------------------------------|--|
| Human Factors Considerations |  |
|                              |  |
|                              |  |
|                              |  |
|                              |  |
|                              |  |
|                              |  |
|                              |  |
|                              |  |
|                              |  |

INDEX TO DETAILED DESIGN CONSIDERATIONS

The purpose of the information in HEDGE is to enable you to expand your test capabilities in considering the human element. They will provide you with a strategy for viewing an item which is undergoing testing from the standpoint of the soldier who must ultimately operate, maintain, or otherwise utilize it. The use of these materials, in addition to standard Task and Design Checklists and Questionnaires, will enable you to tailor your HFE subtest to a specific item.

These materials have been prepared especially for you:

1. They are intended to support test engineers not design engineers.
2. They were designed with your specific tasks in mind, i.e., preparing a Test Plan, conducting a test, analyzing and interpreting test data, and generating the test report.
3. They were prepared under the cognizance of the TECOM Human Factors Engineering Directorate and will enable you to perform your job or to seek their guidance and assistance in a more efficient manner.

Becoming  
competent  
intelligence

Control

The

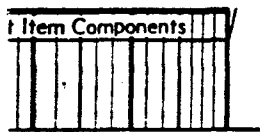
These

Details

The  
will  
ready



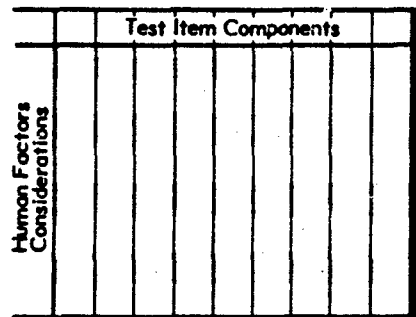
Identify Test Item Components  
and Human Factors Considerations



DESIGN CONSIDERATIONS

#### STEP 4

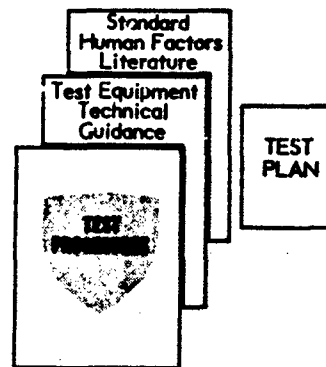
Locate Criteria



DETAILED DESIGN CONSIDERATIONS

#### STEP 5

Prepare Human Factors  
Engineering Subtest Plan



Because these materials offer you a strategy for conducting human factors testing rather than a compendium of facts, the results which you obtain will be directly proportional to your intelligent and common sense application of the data presented.

#### Contents of HEDGE (Human Factors Engineering Data Guide for Evaluation)

The HEDGE materials consist of three major parts:

1. The Index (Page 4).
2. Detailed Human Factors Engineering Test Data (Pages 6-47).
3. The Figures (Pages 48-66).

These materials supplement the Test Procedures, Part I of this TOP.

#### Detailed Steps

The diagram above illustrates the steps necessary to use HEDGE. The paragraphs which follow will detail each step in turn. The Human Factors Engineering Directorate at TECOM stands ready to assist or advise you.



## **STEP 1**    Enter the Index

**STEP**

### **A.**    How to Use the Index

1. Identify the Test Item Class which best defines the item you are going to test.
2. Select the Subclass which most closely identifies the item. You may find it useful to refer to the Definitions (Page 4) for assistance.
3. Determine which Test Function(s) you are concerned with (test of item operability, maintainability, etc.).
4. Note the page number(s) for the data sheets you will be utilizing.

- B.**    How to Classify an Unlisted Item Some items may be particularly difficult to classify because of their unusual characteristics. However, if you carefully study the definitions provided you should be able to place any item of equipment under one of the subclasses presented in the Index. If in doubt, consult the Human Factors Engineering Directorate.

**STEP**

## **STEP 2**    Identify User Functions and Tasks

Each reference in the Index will locate a set of two detailed data sheets. The left-hand page of each set of detailed data sheets, the Man/Item Task Sheet, is designed to aid you in the selection of what to test. The right-hand page, the Detailed Design Considerations, is designed to aid you in the selection of criteria to be used in the tests.

The left-hand page of each set of detailed data sheets presents the Man/Item Tasks. The Man/Item Tasks describe the way in which the soldier and his equipment will interact to form a system. They provide the framework for the human factors test and analysis. The performance of an individual and the performance of the item cannot be analyzed separately. You should keep this concept in mind as you plan and conduct your test. The actual formulation of a human factors Task Checklist can be very simply derived by utilizing the Man/Item Task Sheet (left-hand page). You need merely transcribe the material going down the sheet from the general functions to the Man/Item Tasks, adding qualifiers and specifics as necessary for the item under test. A Task Checklist form is provided in Appendix A of the Test Procedures. Sample Task Checklists are provided in Appendix B of the Test Procedures.

## **STEP 3**    Identify Relevant Item Components and Human Factors Considerations

At the bottom of each left-hand page is a matrix of human factors considerations and item components. The test engineer should review the Task Checklist and the test item design description to identify which of the Test Item Components presented in the matrix apply to the item under test, and which Human Factors Considerations are important.



**STEP 4** Locate Criteria

Each cell in the matrix at the bottom of the left-hand page associated with specific Test Item Components and Human Factors Considerations also has criteria information in the associated cell of the right-hand page. The test engineer therefore only needs to go from cells of the left-hand matrix, which he has identified as important for his test, to cells containing the criteria data on the Detailed Design Considerations (right-hand page). A Design Checklist is made up by listing all the detailed design considerations appropriate to the item under test. A Design Checklist form is provided in Appendix A of the Test Procedures. Sample Design Checklists are provided in Appendix C of the Test Procedures.

**STEP 5** Prepare Human Factors Engineering Subtest Plan

Based on the outputs of the above steps the test engineer is ready to prepare his test plan. The format of the test plan should follow that established in TECOM Regulation 70-24. The sections of the plan includes

1. Objective

The statement of objectives is taken directly from the Objective at the top of the left-hand page of HEDGE.

2. Criteria

The criteria for Design Tests are derived from the right-hand pages of HEDGE and from the Figures (pages 48-66) referenced by these right-hand pages. Other criteria are noted in paragraph 5.X.2 of Part I of this TOP, Test Procedures, where "X" represents the Specific Test Procedure under consideration.

3. Facilities and Instrumentation

Facilities and instrumentation are given in paragraph 5.X.3 of Part I, Test Procedures.

4. Method

Guidance for test and analysis is provided in paragraph 5.X.4 of Part I, Test Procedures.

5. Data Required

Guidance for data required is obtained from paragraph 6.0 of Part I, Test Procedures, and is modified by the appropriate Specific Test Procedure (5.X.6).

6. Data Reduction and Presentation

Guidance for data presentation is obtained from paragraph 7.0 of Part I, Test Procedures, and is modified by the appropriate Specific Test Procedure (5.X.7).



| TEST ITEM CLASSES   | TEST FUNCTIONS<br>(PAGES<br>AS NOTED) | OPERABILITY  | MAINTAIN-<br>ABILITY | TRANSPORT-<br>ABILITY<br>40-41 | PORTABILITY/<br>USABILITY<br>42-43 | ERECTABILITY<br>44-45 | HABITABILITY<br>46-47 |
|---|---------------------------------------|--------------|----------------------|--------------------------------|------------------------------------|-----------------------|-----------------------|
| <b>I. VEHICLES</b>  |                                       | <b>30-31</b> |                      |                                |                                    |                       |                       |
| <b>A. MANEUVERING</b><br>Trucks, Boats, Landing Craft, Tanks, Aircraft,<br>Self Propelled Guns  | <b>6-7</b>                            | ●            | ●                    |                                |                                    |                       |                       |
| <b>B. AIR</b><br>Airplanes, Gliders, Helicopters  | <b>8-9</b>                            | ●            | ●                    |                                |                                    |                       |                       |
| <b>C. NON-MANEUVERING</b><br>Vans, Railroad Cars, Barges, Cargo Trailers  | <b>10-11</b>                          | ●            | ●                    |                                |                                    |                       |                       |
| <b>II. WEAPONS</b>  |                                       | <b>32-33</b> |                      |                                |                                    |                       |                       |
| <b>A. INDIVIDUAL</b><br>Rifles, Sidearms, Aircraft Mounted Weapons,<br>Hand Grenades  | <b>12-13</b>                          | ●            |                      | ●                              |                                    |                       |                       |
| <b>B. CREW SERVED</b><br>Howitzers, Mortars, Missile Sites, Anti-Aircraft<br>Guns, Tank Mounted Guns  | <b>14-15</b>                          | ●            | ●                    | ●                              | ●                                  |                       |                       |
| <b>C. AMMUNITION</b><br>Bombs, Artillery Rounds, Mines, Missiles, Dem-<br>olition Explosives, Clip & Belt Ammunition  |                                       |              | ●                    | ●                              |                                    |                       |                       |
| <b>III. MATERIEL HANDLERS</b>   |                                       | <b>34-35</b> |                      |                                |                                    |                       |                       |
| <b>A. MAN-OPERATED</b><br>Cranes, Booms, Winches, Power Shovels, Hand<br>Trucks, Fork Lifts, Sleds  | <b>16-17</b>                          | ●            | ●                    |                                | ●                                  |                       |                       |
| <b>B. MAN-MONITORED</b><br>Conveyor Belts, Chutes, Hoses, POL Storage &<br>Distribution, Liquid Loaders, Pressure Cylinders                                 | <b>18-19</b>                          | ●            | ●                    |                                |                                    |                       |                       |
| <b>IV. ELECTRONICS/SIGNALS</b>  |                                       | <b>36-37</b> |                      |                                |                                    |                       |                       |
| <b>A. SENSORS</b><br>Radars, Mine Detectors, Range Finders, Prox-<br>imity Warners, Radiation & Chemical Sensors  | <b>20-21</b>                          | ●            | ●                    | ●                              |                                    |                       |                       |
| <b>B. INFORMATION COMMAND-CONTROL SYSTEMS</b><br>Recorders, Information Retrieval & Optical<br>Systems, Amplifiers, Avionics, Data Processers               | <b>22-23</b>                          | ●            | ●                    | ●                              |                                    |                       |                       |
| <b>V. OPERATIONAL SUPPORT</b>   |                                       | <b>38-39</b> |                      |                                |                                    |                       |                       |
| <b>A. MAINTENANCE &amp; REPAIR EQUIPMENT</b><br>Hand Tools, Service and Lubrication Equipment,<br>Inspection Devices, Pipeline Cleaners                     | <b>24-25</b>                          | ●            | ●                    |                                |                                    |                       |                       |
| <b>B. MATERIEL PRODUCTION &amp; ENVIRONMENT CONTROL</b><br>Printing Presses, Bakeries, Machine Tools, Dust<br>Controllers, Dehumidifiers, Noise Attenuators | <b>26-27</b>                          | ●            | ●                    |                                |                                    |                       |                       |
| <b>C. MAJOR CONSTRUCTION ITEMS</b><br>Erection Kits, Portable Shelters, Prefabricated<br>Buildings, Towers, Antennas  |                                       |              | ●                    |                                | ●                                  |                       |                       |
| <b>VI. TROOP SUPPORT</b>  |                                       |              |                      |                                |                                    |                       |                       |
| <b>A. CONSUMABLES</b><br>Foods, Medical Supplies, Skin Ointments  | <b>28-29</b>                          |              | ●                    |                                |                                    |                       |                       |
| <b>B. CLOTHING</b><br>Protective, Regular   |                                       |              |                      | ●                              |                                    |                       |                       |
| <b>C. PERSONAL EQUIPMENT</b><br>Protective Equipment, Mess Gear, Back Packs,<br>Sleeping Gear, Entrenching Tools, Skis                                      |                                       |              |                      | ●                              |                                    |                       |                       |
| <b>D. LIVING &amp; WORKING AREAS</b><br>Tents, Shelters, Vans   |                                       |              |                      |                                |                                    |                       | ●                     |

TEST

i.

II.

III.

IV.

V.

VI.



SECURITY  
47

## TEST ITEM CLASSES

- I. VEHICLES - Items that move personnel or materiel from place to place.
  - A. MANEUVERING - Items that use their own power on the surface of land or water.
  - B. AIR - Items that move through the air.
  - C. NON-MANEUVERING - Items that use a prime mover.
- II. WEAPONS - Items that are used in offensive or defensive combat.
  - A. INDIVIDUAL - Items that are used by a single person.
  - B. CREW SERVED - Items that are operated by two or more people.
  - C. AMMUNITION - Explosive items used in weapons as well as those that are complete weapons within themselves.
- III. MATERIEL HANDLERS - Items that distribute or move materiel.
  - A. MAN-OPERATED - Items requiring direct action by an individual for loading, distributing or moving materiel.
  - B. MAN-MONITORED - Items in which the personnel function is limited to initiating, monitoring, and terminating the loading, distributing or moving of materiel. The monitoring function will include verification and such corrective action as may be required.
- IV. ELECTRONICS SIGNALS - Items used for the transmitting, receiving, disseminating and storing of information.
  - A. SENSORS - Items that detect the presence of metals, electromagnetic and nuclear radiation, noxious gases and other objects.
  - B. INFORMATION/COMMAND-CONTROL SYSTEMS - Items used in the collection, processing and presentation of data.
- V. OPERATIONAL SUPPORT - Items used in construction, production and maintenance of materiel, control of environment, and performance of various troop and unit support services.
  - A. MAINTENANCE & REPAIR EQUIPMENT - Items used to assemble, maintain and repair equipment.
  - B. MATERIAL PRODUCTION & ENVIRONMENT CONTROL - Items used to control or modify the environment, produce materials, or to supply support services to troop units.
  - C. MAJOR CONSTRUCTION ITEMS - Oversized items requiring major assembly.
- VI. TROOP SUPPORT EQUIPMENT - Items primarily used for individual troop support and subsistence.
  - A. CONSUMABLES - Items eaten, drunk or medically used.
  - B. CLOTHING - Items protecting the body under normal or emergency conditions.
  - C. PERSONAL EQUIPMENT - Items carried and/or used by an individual.
  - D. LIVING & WORKING AREAS - Items used by personnel while working or relaxing.



## TEST FUNCTIONS

**OPERABILITY** - The purpose of this test function is to determine the adequacy of the man/machine combination to perform in conformance with the requirements delineated in the military and technical characteristics and standard military specifications.

This test function includes, but is not limited to, test item components and procedures required for:

1. Item set-up
2. Connection with other items
3. Operational check-out
4. Adjustments, calibrations, and tightening
5. Gaining access and egress
6. Activation and deactivation of item
7. Performance of required function
8. Accommodation of item and operator to various operating conditions

**MAINTAINABILITY** - The purpose of this test function is to determine if the item can be maintained under field conditions at the level specified by the directive. In some cases the maintenance requirements will be precisely defined. In others, you will have to make this determination based on your experience with similar items.

This test function includes, but is not limited to, the components and procedures required for:

1. Routine operator-performed preventive maintenance checks and tasks (scheduled maintenance)
2. Contingency tasks, field-operator level (non-scheduled maintenance)
3. Detection of malfunctions
4. Troubleshooting
5. Removal, repair, and replacement of components

**TRANSPORTABILITY** - The purpose of this test function is to evaluate the test item for adequacy of the human factors aspects of moving the item by rail, air, water, or land. Many of the items sent to TECOM are tested for this aspect only (i.e., missile trailers, weapons, various types of electronic gear, etc.). Some of the items which seem to be clearly within this function, however, may include man/item interactions other than those involved in transportability. A line-haul test of a vehicle for example, may involve the engineering testing of operating components, but also requires that it can be driven and maintained during the test. If you wish to evaluate the item for the ability of operators to drive it, consult the "Operability" test function for detailed guidance. By the same token, if you wish to evaluate the item for maintenance design, consult the "Maintainability" test function.

When the test is limited to those aspects of the item which pertain to transporting it by means other than its own power, the human factors portion of your evaluation should include, as a minimum, the testing of components and procedures for:

1. Preparation of item for transfer (crating, removal of projections, fastening down of loose elements)

PORTAB  
as design  
other tes

The testi

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

ERECTA  
field conc  
bridges, p  
under the

The erect

- 1.
- 2.
- 3.
- 4.
- 5.

HABITAB  
building a

This test

- 1.
- 2.
- 3.
- 4.



2. Attaching of cables, hooks, etc. to item
3. Pushing, sliding, or lifting the item
4. Tying down of the item in the carrier vehicle

**PORTABILITY/USABILITY** - The purpose of this function is to determine whether the item can be carried and used as designed by a fully encumbered combat soldier and also to ascertain if it will interfere with the performance of other tasks required of the man.

The testing for this function includes, but is not limited to, consideration of components and procedures involved in:

1. Preparing item for carrying (place in carrying case, disassemble, etc.)
2. Loading item on body (in pack or carrying case)
3. Lifting and transporting item
4. Performing required functions with item loaded on body
5. Unloading item
6. Use of item in a combat situation

**ERECTABILITY** - The purpose of this test function is to determine the adequacy of a test item for assembly under field conditions, where the assembly function is considered to be of primary importance, as it is with certain bridges, pipelines, prefabricated buildings, plugging in of power sources. These types of tasks should be considered under the operability test function relevant to the item.

The erectability test function includes, but is not limited to, the test item components and procedures required for:

1. Pre-erection alignment of parts
2. Connection of components
3. Sealing of joints
4. Testing of item integrity after erection
5. Disassembly of item after use

**HABITABILITY** - The purpose of this type of test is to determine whether the design of the tent, shelter, or building allows the using personnel to live, work, and move about the inhabited space.

This test includes the equipment components and activities required for:

1. Moving about and carrying materiel
2. Performing duties
3. Resting, relaxing, eating and taking care of personal hygiene
4. Life support and sustaining environment



| Test Item                   | Labels<br>Manuals<br>Markings<br>(1) | Steps<br>Ladders<br>Platforms<br>(2) | Handholds<br>Railings<br>(3) | Head-<br>holds<br>Railings<br>(3) | Doors<br>Hatches<br>Passages<br>(4) |
|-----------------------------|--------------------------------------|--------------------------------------|------------------------------|-----------------------------------|-------------------------------------|
| A. LITIGATION & ARRANGEMENT | A                                    | A                                    | A                            | A                                 | A                                   |
| B. SIZE & SHAPE             | B                                    | B                                    | B                            | B                                 | B                                   |
| C. DIRECTION & FORCE        |                                      | C                                    |                              | C                                 | C                                   |
| D. CLEARANCE                | D                                    | D                                    | D                            | D                                 | D                                   |
| E. VISIBILITY               | E                                    | E                                    | E                            | E                                 | E                                   |
| F. USE CONDITIONS           | F                                    | F                                    | F                            | F                                 | F                                   |
| G. SAFETY                   | G                                    | G                                    | G                            | G                                 | G                                   |
| H. OPERATING INSTRUCTIONS   | H                                    | H                                    | H                            | H                                 | H                                   |



## MANEUVERING

Operational conditions - time critical operations (emergency egress) and combat conditions (blackout, butted up, alternate tactical situations, etc.).

| PREPARE FOR OPERATIONS   |   | OPERATE   |  |
|--|---|---|--|
|  | TAKE/LEAVE POSITION   | START/MONITOR/STOP  | CONTROL/DIRECTION/SPEED  |
| the design of<br>instruments, displays,<br>providing cues<br>of a state of | <p><b>PURPOSE:</b> To evaluate the design of the entryway and workspace for ease of getting into the normal working position and preparing or ceasing operation, including donning and doffing as well as stowing and unstowing personal gear and encumbrances, and emergency egress.</p> | <p><b>PURPOSE:</b> Evaluate the design of controls and displays as they relate to normal work position for starting and stopping engine, for monitoring engine functions, and for detecting possible engine malfunctions.</p> | <p><b>PURPOSE:</b> Evaluate the design of the total item, and specifically of controls, displays and workspace under operational conditions including backing and turning for ground vehicles and boats.</p> |
|  | <p><b>MAN/ITEM TASKS</b></p>  | <p><b>MAN/ITEM TASKS</b></p>  | <p><b>MAN/ITEM TASKS</b></p>   |
| steering control   | Step through entry.   | Remove restraints (wheel chocks/dock lines/etc.).   | View external conditions by means of mirrors/ windows.   |
| of integrity/  | Take/leave seat.  | Read labels.  | Check maps/charts.   |
| where appli-   | Doff/don clothing items.  | Preset operating controls (choke/throttle/gearshift/etc.).  | Identify destination/route.  |
| are read and   | Place clothing/tools/weapons/etc. into storage area.  | Activate vehicle.   | Operate steering control.  |
|  | Adjust seats/windows/belts/mirrors.   | Check displays.   | Operate directional control.   |
|  | Adjust seat belts/shoulder harness.   | Manipulate controls.  | Operate speed control.   |
|  |   | Communicate with crew members and/or passengers.  | Operate environment controls.  |
|  |   | Perform post operational check (follow procedures if applicable).   | Operate lighting controls.   |
|  |   |   | Operate visibility controls.   |
|  |   |   | Avoid obstacles.   |
|  |   |   | Communicate with crew/other vehicles/command post.   |

[illegible]



## DESIGN COMPONENTS

### HUMAN FACTORS CONSIDERATIONS

#### A. LOCATION & ARRANGEMENT

The positioning of a component so it affects the ability of the operator to reach, operate or manipulate it, including location of openings (access, egress, cover or door openings, location of components (knobs, levers, etc.) as well as its relationship to other components.

#### B. SIZE & SHAPE

The maximum and/or minimum dimensions of components that are required for adequate man use, including the effects of anthropometric and special clothing (arctic, NBC) considerations, and the shape and contour of handles, knobs and other controls to enhance both the identification and use of the component.

#### C. DIRECTION & FORCE

The movement and/or force required to operate or generally manipulate a component (knobs, controls, fasteners, etc.) with emphasis on the direction of motion corresponding to the display, component, total item reaction or standard practice as well as the minimum strength required.

#### D. CLEARANCE

The unobstructed area surrounding a component which allows the operator to perform required actions, the adequacy of which varies as a function of the amount of body involved (hand, fingers, arm, torso, etc.) and, where appropriate, will also include considerations such as gloves, boots, helmets, protective clothing, etc.

#### E. VISIBILITY

Those aspects of a component that contribute to the operator's ability to see it clearly, including location, size, shape, color, contrast, field of view, viewing distance, reflectance, and illumination.

#### F. USE CONDITIONS

Those aspects of a component that pertain to its operational status before, during and after use, as well as the maintenance of an acceptable environment in the workplace area.

#### G. SAFETY

Those aspects of a component that could cause injury to the operator or other personnel, including preventive aspects for bad weather or reduced visibility, accidental contact with electrical, temperature, chemical, radiation and pressurization hazards, and danger to sight and hearing, particularly under the conditions of alert or battle stress.

#### H. OPERATING PROCEDURES

Those operational and informational aspects affecting or improving man performance as found in equipment design handbooks as well as job aids, checklists, training tests, troubleshooting guides and repair manuals with specific attention to the safety aspects when using the components.

## 1. LABELS, MANUALS, MARKINGS

Provide technical guidance in the form of written material, schematics, diagrams, illustrations and instruction plates.  
Make operator aware of hazards.  
Give special guidance or instructions.

- Controls, displays, etc. are clearly, appropriately labeled except where use is obvious.
- Labels placed on or near items they identify.
- Do not cover other information.
- Label is not behind control.
- Label location consistent.
- ID labels not obscured by components on flattest surfaces on main chassis; min coverage by grimes not easily removed.

- Character height determined by distance read, luminance FIG 1.B.1.
- Group label characters larger than those of controls, displays which are larger than control, display position characters each by 25% min.
- Letter, numeral styles FIG 1.B.2-4.
- Height/width ratio = 5/8; "a" is 1 stroke width wider; "m" & "n" are 5/8 "i" & "l" are 1 stroke width.
- Stroke width for black (white) characters on light (black) backgrounds 1/6 (1/7-1/8) of height.

- Spacing between characters (words) one stroke (character) width min.
- Line spacing = character height.
- Counter numeral two ratios = 1:1 (except 1) separation = 5 to 6.
- Optical projections all caps, stroke width 1/6 to 1/8; exceeds 15 minutes visual angle.
- Thumbwheel numeral line ratio = 3/2; h = 1/2 stroke width internally (externally) illuminated = 10:1 (5:1).
- Abbreviations all caps, no periods.
- Extended copy use lower case.
- Label characteristics determined by illumination level, color.
- Labels easily, accurately read at operational reading distance, vibration, light levels, environmental conditions.
- Labels are sharp with high or color contrast.
- With illumination above 1 f-c: black letters, light background.
- Dark, adaptation letters visible, do not interfere with night vision.
- Chart readings FIG 1.E.3.
- Label characteristics accurate, required line available; distance light level, color criticality of function consistency of design.
- Labels on production equipment are as durable as the equipment.
- Labels for parts - equipment easily affixed, or removed.
- Labels not obscured by other units near obscured by paint, dirt.
- Markings, tags are as permanent, available as equipment.
- Remove materials avoided.
- Vertical labels used only when labels are not critical for personnel safety, performance.
- Electrical receptacles marked with voltage phase frequency.
- Pipes, hoses, tube lines clearly labeled as to contents, pressure, temperature, hazards.
- Warning placards illuminated.
- Placards adjacent to hazards.

- Character height determined by distance read, luminance FIG 1.B.1.
- Group label characters larger than those of controls, displays which are larger than control, display position characters each by 25% min.
- Letter, numeral styles FIG 1.B.2-4.
- Height/width ratio = 5/8; "a" is 1 stroke width wider; "m" & "n" are 5/8 "i" & "l" are 1 stroke width.
- Stroke width for black (white) characters on light (black) backgrounds 1/6 (1/7-1/8) of height.

- Spacing between characters (words) one stroke (character) width min.
- Line spacing = character height.
- Counter numeral two ratios = 1:1 (except 1) separation = 5 to 6.
- Optical projections all caps, stroke width 1/6 to 1/8; exceeds 15 minutes visual angle.
- Thumbwheel numeral line ratio = 3/2; h = 1/2 stroke width internally (externally) illuminated = 10:1 (5:1).
- Abbreviations all caps, no periods.
- Extended copy use lower case.
- Label characteristics determined by illumination level, color.
- Labels easily, accurately read at operational reading distance, vibration, light levels, environmental conditions.
- Labels are sharp with high or color contrast.
- With illumination above 1 f-c: black letters, light background.
- Dark, adaptation letters visible, do not interfere with night vision.
- Chart readings FIG 1.E.3.
- Label characteristics accurate, required line available; distance light level, color criticality of function consistency of design.
- Labels on production equipment are as durable as the equipment.
- Labels for parts - equipment easily affixed, or removed.
- Labels not obscured by other units near obscured by paint, dirt.
- Markings, tags are as permanent, available as equipment.
- Remove materials avoided.
- Vertical labels used only when labels are not critical for personnel safety, performance.
- Electrical receptacles marked with voltage phase frequency.
- Pipes, hoses, tube lines clearly labeled as to contents, pressure, temperature, hazards.
- Warning placards illuminated.
- Placards adjacent to hazards.

- Character height determined by distance read, luminance FIG 1.B.1.
- Group label characters larger than those of controls, displays which are larger than control, display position characters each by 25% min.
- Letter, numeral styles FIG 1.B.2-4.
- Height/width ratio = 5/8; "a" is 1 stroke width wider; "m" & "n" are 5/8 "i" & "l" are 1 stroke width.
- Stroke width for black (white) characters on light (black) backgrounds 1/6 (1/7-1/8) of height.

- Spacing between characters (words) one stroke (character) width min.
- Line spacing = character height.
- Counter numeral two ratios = 1:1 (except 1) separation = 5 to 6.
- Optical projections all caps, stroke width 1/6 to 1/8; exceeds 15 minutes visual angle.
- Thumbwheel numeral line ratio = 3/2; h = 1/2 stroke width internally (externally) illuminated = 10:1 (5:1).
- Abbreviations all caps, no periods.
- Extended copy use lower case.
- Label characteristics determined by illumination level, color.
- Labels easily, accurately read at operational reading distance, vibration, light levels, environmental conditions.
- Labels are sharp with high or color contrast.
- With illumination above 1 f-c: black letters, light background.
- Dark, adaptation letters visible, do not interfere with night vision.
- Chart readings FIG 1.E.3.
- Label characteristics accurate, required line available; distance light level, color criticality of function consistency of design.
- Labels on production equipment are as durable as the equipment.
- Labels for parts - equipment easily affixed, or removed.
- Labels not obscured by other units near obscured by paint, dirt.
- Markings, tags are as permanent, available as equipment.
- Remove materials avoided.
- Vertical labels used only when labels are not critical for personnel safety, performance.
- Electrical receptacles marked with voltage phase frequency.
- Pipes, hoses, tube lines clearly labeled as to contents, pressure, temperature, hazards.
- Warning placards illuminated.
- Placards adjacent to hazards.

- Character height determined by distance read, luminance FIG 1.B.1.
- Group label characters larger than those of controls, displays which are larger than control, display position characters each by 25% min.
- Letter, numeral styles FIG 1.B.2-4.
- Height/width ratio = 5/8; "a" is 1 stroke width wider; "m" & "n" are 5/8 "i" & "l" are 1 stroke width.
- Stroke width for black (white) characters on light (black) backgrounds 1/6 (1/7-1/8) of height.

- Character height determined by distance read, luminance FIG 1.B.1.
- Group label characters larger than those of controls, displays which are larger than control, display position characters each by 25% min.
- Letter, numeral styles FIG 1.B.2-4.
- Height/width ratio = 5/8; "a" is 1 stroke width wider; "m" & "n" are 5/8 "i" & "l" are 1 stroke width.
- Stroke width for black (white) characters on light (black) backgrounds 1/6 (1/7-1/8) of height.

## 2. STEPS, LADDERS, PLATFORMS

Provide a surface to accommodate user's feet while climbing or conducting routine checks and for the temporary placement of loads.  
Wheels, hubs and structural members used for climbing are evaluated as ladders.  
Angle of ascent: defensible ladders, 75°-90°; steep ladders, 50°-75°; steep, 20°-50°; ramps, 0°-20°; platforms, 0°.

- Adequate footholds provided for crew to reach hatches from ground.
- Sequence of stepping points and with proper man orientation to door or entryways.
- Step surfaces within, without work-space easily reached from either direction.

- Cross (limiting) dimensions based on 95th (5th) body dimensions of users FIG 2.B.1-7.
- Stair, stair-ladder, fixed-ladder dimensions do not exceed the max. min dimensions FIG 2.B.1-3.
- Stairs, ladders accommodate 5th - 95th % user wearing arctic clothing FIG 2.B.8.

- Folding ladder lift height 9' max.
- One man limits to lift, shore ladders 9' for 20 lb; 6' for 25 lb.
- Stairs, ladders, platforms, ramps without heaviest combined weight of user plus equipment plus safety factor.

- Finger clearance to be provided in folding steps, ladders.
- Step width, spacing accommodate lower FIG 2.B.8.
- Folding ladder catches, ladders operable with cold-wet arctic mittens FIG 2.B.11.

- Visual obstructions, blind footholds avoided.
- Tools contrast with structure, conspicuous in dim light.
- For reduced lighting reflective materials used.

- Stair-ladders are of metal with the tread rise open at rear.
- Exterior personnel platforms, work areas: Open metal grating or mesh shield surface.
- Steps visible if wet, icy.

- Ladders are not provided when equipment is to be hand carried.
- Open personnel platforms have a toe board, screen 3" h min.
- Safety mesh under open gratings.
- Obstructions, sharp edges are padded.
- Ladders located away from moving parts, electrical sources.

- Footholds marked, identified.
- "No Step" markings if applicable.
- Warnings labels for hazards.
- Procedures listed for moving, replacing ladders, ramps.

## 3. HANDLES, HANDGRIPS

Assist users to mount and enter the item and to maintain balance.  
Supply leverage and support to a climbing or working man.  
Door handles, structural members, etc., used for gripping or balance, are evaluated as handholds.

- Adequate hand grips provided for crew to reach hatch from ground.
- Handholds furnished where needed within easy reach.
- Handholds integrated with doors, entry ways for stability.
- Adequate handholds for balance while moving.

- Handhold dimensions FIG 2.B.1-3.
- Handhold length: 6" min.
- Handhold opening: 6" x 4" min.
- Shaped handholds improve grip.

- Handhold dimensions FIG 2.B.1-3.
- Handhold length: 6" min.
- Handhold opening: 6" x 4" min.
- Shaped handholds improve grip.

- Handhold dimensions FIG 2.B.1-3.
- Handhold length: 6" min.
- Handhold opening: 6" x 4" min.
- Shaped handholds improve grip.

- Handholds do not intrude into work-space.
- Handhold accommodates arctic gloves FIG 2.B.11.

- Handholds clearly visible from inside and out prior to grasping.
- Color coded to enhance visibility, prevent grasping errors.

- Handholds usable if wet, icy.
- Handgrip usable with bare hands in hot climates, high temp.
- Collapsible handholds overtable while wearing arctic mittens.

- Handgrip cross over from cables, lines, hot pipes, other hazards.
- Inappropriate structures, wires cannot be used as handholds.
- Railings no projections, snags.

- Handgrip cross over from cables, lines, hot pipes, other hazards.
- Inappropriate structures, wires cannot be used as handholds.
- Railings no projections, snags.

- Handholds marked, identified.

## 4. DOORS, HATCHES, PASSAGES

Provide a means for entering and leaving the work-space.  
Provide openings for loading or unloading material.  
Components are evaluated for both normal and emergency use.  
Some doors serve dual purposes and must also be evaluated as steps, ramps or platforms.

- Wall hatches flush with floor where structurally possible.
- Latch handles can be reached from normal approach positions.
- Door, hatch latch, latch is easily reached from seated positions.
- Handgrips, footholds help user reach hatch easily.
- Overhead hatches: latch to hold open inside paddled 1 hand operation.

- Rectangular hatch also FIG 4.B.1.
- Circular hatch: 30" min dia.
- Oval hatch: 17" x 20" min.
- Trailer vans, portable shelters with one ft min user 76", 30" x min.

- Hatch handle unlatching forces: 20 lb max.
- Overhead hatch: opening forces, 30 lb max operable by user with 5th % arm, hand strength FIG 4.C.1.
- Hatch opening forces: 30 lb max.
- Handles operable with gloves.

- Fixed equipment is located 3' min from swept area of doors.
- Cross (limiting) dimensions based on 95th (5th) body dimensions of users FIG 2.B.1-7.
- Floor escape hatches: 22" min dia, 10" above ground.
- Handles, handgrips usable with arctic mittens FIG 2.B.11.
- Entry, egress possible wearing boots.

- Latch control visible initially.
- Door jamb or opening height allows full view of step point.
- "See thru" on vis possible.

- Hatches open with a single motion of hand, foot.
- If "step down" through a top access exceeds 27", appropriate foot rests.
- Trailer hatches do not freeze up.
- Latch handles do not freeze up.
- Doors lockable from inside.
- Handles uniform in operation.

- Doors, emergency exits are easily reached, unlatched, quick opening 7 sec max, 16-20 lb. operating forces.
- Escape openings smooth-edged, no obstructions, permit passage with survival equipment.
- Glass in doors shatterproof.

- Color of latch handle different from that of door.
- Correct movement of latch handle diagrammed, labeled.
- Exit instructions are legible, brief, clearly worded.

- Battery terminals marked "+", "-".
- Which instruction of RIFs, lists, jacks.
- Oil sticks color coded.
- Airbrake, hydraulic line of each end.
- Fuel tank capacity 1.
- Tire pressure labels.
- Special handling, egress procedures, pre weather emergency.

## 5. EXTERNAL CUM

Components outside and serving positive checkout and which are operation, loading, fire tires, lights, pipes, test points, sticks, wrenches, start keys, internal handles or platforms.

- Drain valves: run accessible, reliable.
- Filters accessible for.
- Components require are readily accessible.
- Drain valves: either is to be checked, initial.
- Spare tire can be c when stored.
- Special tools for repair mounted nearby.
- Fuel fill-pipe outside.

- Cross (limiting) dimensions based on 95th (5th) body dimensions of users.
- Drain plugs, valve number of sizes min.
- Canister vehicle fuel over (under) 50 gal at 50 gal/min (with).
- Components can removed, installed u less.
- Small parts handle nuts are captive.

- Mixed access cover: battery removable.
- Spare tire easily re in carrier with vehicle.
- Jacking operation is.

- Size of access large hand, arm, head, in.
- One large access in.
- Safety chains do not connect air, hydraulic line.

- Trucks have glow-type & motor out of the cab.
- Which operation: hatch works, cab last.
- Timing marks, a minimum parallel, 1.
- Mirrors bracketed equal.
- Components which are color-coded, background.

- Windshield wipers, 1.
- Wiper blades reposition when turned off.
- Trailer brake cables when positioning 1 not amount to half.
- Positioning: no-down installed, removed.
- Which & vehicle possible of simultaneous.
- Which cable easily 1.
- Which controls open well as from which.
- Windshield wipers manually if power 1.
- Fuel tank, lines are cte body.
- Bus exhaust pipe rear body.
- Exhaust system: to no user control costs.
- Batteries well vented.
- Two separate ways.

- Battery terminals marked "+", "-".
- Which instruction of RIFs, lists, jacks.
- Oil sticks color coded.
- Airbrake, hydraulic line of each end.
- Fuel tank capacity 1.
- Tire pressure labels.
- Special handling, egress procedures, pre weather emergency.



entering and  
making an en-  
try for both  
purposes and  
then, return

Components outside of cab or normal working position involved in checkout and which are necessary for operation, landing, tie-down, etc.

Tires, tracks, lights, batteries, ventilators, test panels, indicators, dipsticks, sensors, starter cranks, pulleys, master/slave handles, etc.

Handles, grips, knobs, switches, triggers, levers, wheels, pedals and other man operated items as applicable.  
Controls are associated only with the item under test, not with equipment placed on it.

Components that provide visual and auditory information  
Provide positive indication of developing or current malfunctions  
Displays are associated only with the item under test, not

Your stove  
 cooked from  
 its  
 it is empty  
 strong.  
 it was rough  
 to the hard  
 hard again-

NG 481.  
66  
in  
letters with  
J. W. Allen.

approx 20 lb  
of force, SO  
- with 570lb  
A.C.L.  
to max.  
with

test 3<sup>rd</sup> min  
" on board on  
upper water  
min die. 18"  
stop with  
wearing

city  
right officers

the motion  
has across  
last night,  
it will.

are easily  
ick oper-  
ating

edged, no  
ings with

ent from  
to handle  
or, brief,

- Drain valves: man, number, readily accessible, reliable, hand operated.
- Drain covers: easily removable.
- Components requiring adjustment are readily accessible.
- Dual wheels allow inner, outer tire to be checked, inflated.
- Spare tire can be checked, inflated when stowed.
- Special tools for operational adjustment mounted nearby.
- Fuel fill-cap outside cab, body.
- Gross (forming) dimensions based on 95%th (5th%): see FIG 25.B.1-7.
- Drain plugs, valves same size or larger than hose mounting.
- Carrier vehicle to fuel tanks which are over (under) 50 gal. can be refueled at 50 gal/min (under 1 min/valve).
- Components can be handled, removed, installed using only the materials.
- Small parts handled with metric mallets are captive.
- Hinged access covers open down.
- Battery removable by one man.
- Spare tire easily removed, replaced in carrier with vehicle fully loaded.
- Jacking operation feasible.

- Size of access large enough to insert hand, arm, tool, test equipment.
- One large access preferred over two smaller ones.
- Safety chains do not damage, disconnect air, hydraulic, electrical cable.

- Trucks have glass-proof, steel canopy type 1 weather mirror on each side of the cab.
- Watch operation observable from both within, cab locations.
- Timing marks, other indicators minimum parallax, readily visible.
- Mirrors bracket against vibration.
- Components which must be visible are color-coded, contrast with background.

- Windshield wipers, wiper provided.
- Wiper blades return to stored position when turned off.
- Trailer brake controls: within reach when positioning trailer manually and accessible to traffic.
- All other vehicle facilities easily maintained, removed.
- Wrench & vehicle power train capable of simultaneous operation.
- Wrench cable reel: powered w/ 1 man.
- Wrench controls: operable from cab as well as from reel.
- Windshield wipers can be operated manually if power fails.
- Fuel tanks, lines are not within vehicle body.
- Gas exhaust pipe extends beyond rear body.
- Fuel tank covered, protected to prevent current leak but surfaces.
- Distances well ventilated.
- Two separate ways to apply brakes.

- Battery terminals of different size, marked "+", "-".
- Which instrument visible.
- Weight capacity indicated on stands, lifts, hoists, jacks.
- Dip sticks color coded.
- Airbrake, hydraulic hoses identifiable at each end.
- Fuel tank capacity labeled.
- Tire pressure labeled.
- Special handling, assembly, operating procedures, precautions for cold weather in company store.

- Control relationship to its display is apparent, comparable.
- Functionally related controls are grouped together.
- Control groups, equipped operators have left-to-right and/or top-to-bottom order of use.
- Controls are functional groups are located in accordance with operational sequence and/or function.
- Controls oriented to operator.
- Can not accidentally be moved.
- Recurring groups similar first system.
- Rotary axis, shape FIG 6.8.1-5.
- Linear axis, shape FIG 6.8.1-5.
- Linear axis, shape FIG 6.8.1-5.
- Group (limiting (movable)) dimensions based on 75% (50%) (25-75%) operator.
- Size casting 3 axes max.
- Linear axis, shape FIG 6.8.1-18.
- Isometric joystick: shaft length = 4.3", 7.1" or diameter = 2".
- Isometric joystick: hand-group for integral switching, other group finger-group.
- Adaptive control response feedback.
- Display interface controllers force, displacement FIG 6.8.1-21.
- Switches: force between position, resistance increases until action step.
- Flare valves open CCM.
- Force, displacements (including mixture controls) FIG 6.8.1-21.
- High force controls FIG 6.8.1-2.
- Pedals return to original position after use.

- Control spacing min. FIG 6.D.1;
- blind operation, 5" min.
- Rotary separations FIG 6.B.1-8.
- Linear separations FIG 6.B.9-18.
- Compatible with handwear used.
- Foot switches separated 3" horizontal; 6" vertical minimum.
- Display interface controllers clearances FIG 6.B.19-21.
- Range of control action does not interfere with other controls.

- Shape defined curvilinear viscosity, flexibility identical
- Control contrast with background
- Ambient light color determines usable contrast colors
- Reference line has 50% min contrast with control color
- Pulse rate varies over exposure period
- Threshold adjustable 25% min
- Threshold adjustable internally light if ambient illumination below 1 ft.-c.
- Threshold repeatable 30° off-axis
- Layered switch layout is legible
- Precision of control manipulation is consistent with that of system
- Subsequent vibration, noise of user's limbs are over bordered
- Cooling system throughout system
- Usable in time required despite inadvertent operation production
- Controls not adversely affected by environmental vibration
- Minimum use ratio of horizontal to 3-position toggle switches
- System response time FIG F.6-F.2.

- Blows cutting free of sharp edges.
- Critical controls not susceptible to accidental movement.
- "Dead man" control used when inactivity produces a critical condition.
- Controls that initiate hazardous operations require prior operation of a control.
- Power steering failure does not increase steering.
- Emergency controls located near related warning displays/alarms/indicators.
- Minimum warning required.
- Control color related to display.
- Operating instructions provided except where use is obvious.
- Diagrams used where applicable.
- Position of shift lever shown.
- Position of shift bracket shown.
- Control movements shown parallel to actual control movements.
- Minimum entries are easily recalled.

Internal software checks minimize

- Standardization of keyboards within system.
- Keyboard arrangement, number of keys compatible with info to be entered.
- Hand rest provided for partial angle over 20°.
- Fingers reached easily.
- Keyboards conform to MIL-STD-1780.

- Only 1 switch per font preferred.
- Display interface controllers size, shape: FIG 6.8.19-21.
- Minimize controls used; only under space constraints size & separation time permit.
- Rotary size, shape: I R. 6.8.1-1, R.

- Avoid the requirement of constant force on joystick.
- Isometric joystick: deflection minimal, perceptible.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs. C/D ratios: large (small) for small (large) range of display movement.
- High force controls provide limb/body support; 3 sec. sustained operation max.
- Free from backlash.

- Pointers differentiated for each knob of ganged set.
- Interface controllers: in rate control applications, indicators provided to facilitate returning followers to display.

Isometric joystick uses visual feedback, minimal delays, tight coupling of input/output; return to center after entry requirement. Variable function keys have a visual signal if standard function unavailable. Fixed function keys used for critical or frequent inputs. Cursor control is consistent with speed and accuracy requirements.

Foot-operated switches located away from obstructions.  
Data manipulated without concern for internal storage.

Control inputs result in positive responses displayed to indicate performance. User chooses sequence of transaction. Data entry requires explicit completion actions paced by user. Critical entries require user acknowledgment, can be edited.

Foot-operated control uses force needed greater than upper body; noncritical, frequent operation; alternative shutdown control.  
 Steps at beginning and end of control active positions.  
 Extended maximum force applications avoided.  
 Controller/follower movement ratio, displacement proportional.  
 Conventional control movements FIG. 6.C.3.

humatic joystick delay between control movement and display response .1 sec. max. Recommended manual controls FIG 6.F.1.

100

- Display relationship to control is especially *deformable* (control used, response changes)
- Functionally related units grouped
- Displays, groups have left-to-right and/or top-to-bottom order of use
- Displays located so they can be read in the required degree of accuracy
- Lighted status indicators are consistently associated with controls
- Emergency, critical, important displays located in 30° cone about line of sight
- Display viewing distances 13-20"
- Pointer devices to limit read error or second hand marks useful
- F.E.C. (Feedback Error Compensation) useful to eliminate position, slowness
- Controls, flags, printer, plotter: FIG. 8.8.1.
- CRT target visual angle constant 2.0 minutes, 10 lines of resolution distance 16" (16°) min.
- Numbers, flags, printers, plotters: FIG. 8.8.2.

- Display face to line of sight exceeds 45° in parallel, reflections.
- Frequency of color change constantly in excess of rated zone FIG B.E.1.
- Illumination uniform FIG A.E.3.
- Sparking, visible.
- Contrast, luminance exceeds 50%.
- Flashing lights 3.3 flashes/sec.
- Color coding used where possible unless action covered.
- Indicators and controls illuminated, standard 0.02-1.0 ft-cd.
- Flashing lights 114.
- Display precision, response in constant with that of system.
- Information displayed: Clear, specific, precise, unambiguous not redundant, degraded by vibration and noise.
- Symbols, letters, numbers FIG B.F.1.
- Symbols, letters, start of a, use whole numbers, 2 pointers max, numerals or arched upright.
- Mechanical tones FIG B.F.2.
- Audio signal evolutions FIG B.F.3.
- Audio, verbal warnings 20 dB min over background.
- Feedback, verbal.
- Signal changes due not mean "up".
- Indicator light color coding for emergency, warning, attention, etc FIG B.F.1 master lights on apart.
- Audio warnings transmitted to both cockpits and work area.
- Audio signal action approved specific action problem.
- Prohibited, prohibited signals are not used FIG C.E.1.
- Audio warning duration min of 1 sec until corrective action taken.
- Minimum decoding required.
- Transmitters, irrelevant information, etc do not appear on panel face.
- Coding techniques uniform facilities, consistency, identification, relationship, clarity.
- Auditory displays used where vision overloaded, degraded, redundancy desirable warning, cue needed.
- Verbal warnings intelligible, apt.
- Audio warnings use standard signals.
- Labels functionally basic well located.

- Display pointers common stable
- Circular dials
- Recurring tabs located.
- Tabular data right, top-to-bottom
- All data needed is grouped together
- Simple menus fit on 1 page
- For hierarchical function call

- Illumination balance
- Display pointers
- Data entry by touch
- Groups of information distinctive
- Display frames identified
- Text conform paragraphs separate lines
- Prompts provide information consistently
- Inserted items for display in order
- Data entered by touch, on screen
- Mechanical displays are avoided
- Displays are expected operators
- Speed for manual
- Auditory displays
- Operator and man not combine for both users
- System allowed visual
- Spelling and produce valid

- Auditory displayable.
- Display freeze mode feedback.
- Information generation of like c
- Data presented readable format
- Internally detected explicit, neutral
- Prompts and available for and error locat



## 8 DISPLAYS

Components that provide visual and auditory information to the operator concerning the status of operation. Displays provide indication of developing or current malfunctions. Displays are designated only with the item under test, not with equipment placed in or on it.

- Display relationship to control is apparent; determines control used, equipment displayed.
- Functionally related units grouped.
- Displays, groups have left-to-right and/or top-to-bottom order of use.
- Displays located so they can be read in the required degree of accuracy.
- Lighted control indicators are unambiguously associated with controls.
- Emergency, critical, important displays located in 90° cone about line of sight.
- Display viewing distance: 13-20".
- Pointer extends to but does not obscure or exceed index mark width.
- Pointers are close to dial to eliminate parallax, shadows.
- Displays, flags, pointers, plotters: FIG. 8.B.1.
- CRT target visual angle exceeds 2.0 minutes, 10 lines of resolution distance 16" (10° min).
- Displays, flags, pointers, plotters: FIG. 8.B.1.

- Display pointers are aligned for common scale values.
- Circular dials: FIG. 8.F.X.
- Recurring tabular data is similarly located.
- Tabular data is displayed left-to-right, top-to-bottom.
- All data needed to support activity is grouped together.
- Simple menus used when all selections fit on 1 page.
- For hierarchical menus a direct function call capability is provided.

- Tabular displays used to present raw or derived data.
- Information necessary for selection of control action available when needed.
- Information density held to minimum on critical task displays.
- Standardized data fields used.
- Information displayed limited to that necessary to make decisions.
- Location and presence of control input data clearly indicated.

- Display face to line of sight exceeds 45° min parallax, reflection.
- Frequently used displays grouped in optimal visual zones: FIG. 8.F.1.
- Illumination uniform: FIG. 8.E.3, conspicuously visible.
- Contrast, luminance exceeds 50%.
- Flashing lights: 3-5 flashes/sec.
- Color coding used where possible; unused scales covered.
- Indicators used at night illuminated, dimmable: 0.02-1.0 (1:1).
- Flashing lights synchronized.
- Display precision, response is consistent with that of system.
- Information displayed: Clear, specific, precise, unambiguous; not redundant, degraded by vibrations, timely.
- Lights show functions: FIG. 8.F.1.
- Scales: linear, short of 0, use whole numbers, 2 pointers max, numerals oriented upright.
- Mechanical types: FIG. 8.F.2.
- Audio signal evaluations: FIG. 8.F.3.
- Audio, verbal warnings: 20 dB min over background.
- Failure immediately apparent.
- Signal absence does not mean "go".
- Indicator light color coding for emergency, warning, summation, etc: FIG. 8.F.1; master lights set apart.
- Audio warnings transmitted to both earphones and work area.
- Audio signal action apparent specifies nature of problem.
- Prohibited persistent signals are not used: FIG. 8.G.1.
- Audio warning durations min of 1 sec; until corrective action taken.
- Minimum decoding required.
- Trademarks, irrelevant information, etc do not appear on panel face.
- Coding techniques uniform facilitate discrimination, identification, relationships, criticality.
- Auditory displays used where vision overburdened, degraded redundancy desirable; warnings, cues needed.
- Verbal warnings: intelligible, apt.
- Audio warnings use standard signals.
- Labels: functional; basic; well located; graduated in size.

- Illumination balanced full on to off.
- Display pointer tip same color as marks.
- Date entry by overwriting is not used.
- Groups of information, commands distinctive.
- Display frames and pages uniquely identified.
- Text conforms to MIL-STD-490; paragraphs separated by min. of 1 blank line.
- Prompts provide data and explanations explicitly understandable; use consistent technology.
- Inserted items are collected in buffer, displayed in insert area, and inserted simultaneously.
- Data entered via keyboard are displayed, as keyed, on the screen.
- Mechanical overlays for keyboards, displays are avoided.
- Displays are designed for the expected operational environment.
- Alert for memorization minimized.
- Auditory displays have test device.
- Operator and maintenance information not combined unless compatible for both uses.
- Operator presumption in a crew system allowed only for mission survival.
- Prompting and command errors don't produce valid commands.

- Digital values requiring reliable reading updated 1 per second or less.
- Gross or rate of change values updated between 2 and 5 per second.
- Graphic displays requiring integration of rapidly changing patterns updated consistent with the user's information handling rate.
- Display formats designed to optimize information transfer.
- Stacked, alternately presented legends visible.
- Display changes represent functional state.
- Priority information obvious.
- Transilluminated displays: FIG. 8.F.A-1.
- Transilluminated indicators display system status, immediate actions, adjustment functions.
- Software minimizes operator task complexity.
- Display minimizes acceptance and unavailability of input and delay.
- Expected use of information determines update rates.

- Nomenclature approved by procuring agency.
- Abbreviations from MIL-STD-12, MIL-STD-411, and MIL-STD-783.
- Feedback provided to indicate system status.
- Command lang. as reflects user's point of view.
- Multiple level systems have minimum levels, priority access to critical levels, indicate current position.
- Aided for entry of already available information minimized.

## 10 WORKSPACE

The area within which the user operates the equipment.

Includes space for controls, displays, optics, electronic devices, weapons, and windows as well as standing areas, consoles and seats.

Provides storage for excess clothing, personal gear, weapons and tools.

Protects operator from adverse environment, when applicable.

- Display placement above standing (seated) surfaces normal, 41-70" (6-16°) precisely, frequently read, 50-55" (14-35°), 21° from centerline.
- Controls on vertical surfaces above floor (seated normal, 36-70" (9-30°) precisely, frequently read, 36-52" (9-27°), 21° from user centerline.
- With vision over console top critical warning display 22° min above seat.
- Display reading location identified.
- Equipment designed, installed with workspace requirements in mind.
- Seats fit suitably clothed 5-95th% user without degrading performance.
- Arm rests 24" min.
- Back, seat have 7° min padding.
- Lateral work (writing) space 30" (24" (6°) min.
- Standard consoles: FIG. 10.B.1-3.
- Gross (limiting) dimensions based on 5th & 95th fully equipped user: FIG. 10.B.1-1, Arctic: FIG. 10.B.1-2.
- Adjustable dimensions fit 5-95th%.
- Vehicle operator's seat: FIG. 10.D.4.
- Vertical seat adjustments 15-21° in 1° min increments.
- Seat lumbar sections (B3-B5), supports form to operator's eyes are within 3° of "eye-line".
- Nerve adjust 76-11" above seat.
- Seat adjust fore, aft 4" min.
- Operator does not have to RFL seat to adjust seat.
- Padding does not restrict entry.

- Cabinet kick space: 44" min.
- Console front floor space: 8" min.
- Knee room 25x26x18" min.
- Unusual positions: FIG. 10.D.1-2.
- Allowances made for heavy clothing, protective equipment.
- Vehicle seat: FIG. 10.D.5.
- Workspace anthropometrics: FIG. 10.D.1-2.
- Seat adjustment overhead clearance from seat pan 40" min.
- Overhead clearance takes into account seat stiffening in cold.
- Reflection of instruments, consoles in windows, windshields avoided.
- Right-left viewing angle for wrap-around consoles 190° max.
- Dimensions: FIG. 10.E.1.
- Forward field of view 40° min.
- Trash forward visibility ground beyond 10° to 15° above horizon.
- Views, etc reduce external glare.
- Performance: FIG. 10.E.3.
- No bright work in user's view.
- Door push, other motions do not cause vision.
- Acoustical environment does not degrade system effectiveness.
- Noise levels: FIG. 10.F.2-4.
- Whole body vibration limits X, Y, Z, times: FIG. 10.F.5.
- Vehicle temps 68° F min.
- Fresh air exceeds 20 cfm/min/man hot climate, 150-200 cfm/min/man.
- Windshield defrostable.
- Arctic clothed man not exposed to temp above 60°F; 35-45°F optimal.

- Exposure to gases, fumes, toxicity: see THRESHOLD LIMIT VALUES.
- Impact noise: FIG. 10.G.1.
- Aural non-detection: FIG. 10.G.2.
- Noise duration limits: FIG. 10.G.3.
- Cars have seat belts.
- Windshields, windows are shatter-resistant, don't distort vision.
- Handed alerting device provided.
- Illumination adequate.
- Exposed edges (forward) rounded 0.08" (0.5°) min radius.
- Motion sickness limits: FIG. 10.G.4.
- Adequate, suitable storage for manuals, worksheets, etc.
- Consoles, equipment adjacent to equipment hazardous to user.
- Areas requiring special equipment, clothing are specifically identified.
- Emergency procedures detailed.
- Instructions kept simple.
- Seat adjustment diagrammed.
- Pushed access motions marked.
- Warnings, markings include warnings on their, thermal hazards of hot/cold, exhaust gas.

## 11 COMMUNICATIONS

Devices and techniques for communicating information among crew man within the workspace, between the crew and externally located individuals, and between the crew and remotely located persons.

Includes antennas, where applicable.

- Microphones, headphones, headsets permit hands-free operation.
- Accessible volumes, gain controls are provided for each channel.
- Fast operated "Send-Receive" control when both hands busy.
- Radios, telephones are located for easy emergency access, time critical communications.
- Communication devices are located within easy reach of operator.

- Earphones, headsets easily adjusted, accommodates 5th-95th% user: FIG. 11.B.4.
- Reach to communication controls is unobstructed.
- Workspace accommodates operators wearing earphones, headsets.
- Radio antenna located to minimize radio-frequency hazards.

- Microphones, headphones, single (multi-tilt) speakers: 200-6100 Hz (100-4000 Hz) dynamic range 50 dB min.
- Microphones noise cancelling in 100 dB range 10 dB rms min.
- Filtering, clipping is used to improve intelligibility.
- Discrete headsets used when ambient noise exceeds 85 dBA.
- Volume, gain audible range 110 dB max squarish.
- Volume/power control has delay between min volume, off.
- Communication equipment worn by operator is comfortable; metal parts do not contact user's skin.
- Headsets worn in high ambient noise provide attenuation equal to ear protective devices.
- Exposed metal parts grounded.
- System allows emergency message top priority, does not interfere with their transmission, reception.
- Antennas, waveguides grounded.

- Speaker hears own voice in his headset in phase with his speech.
- Voice communication intelligibility criteria: FIG. 11.H.1.
- Audio signals coded as to maintenance, emergency, health hazard, etc to minimize operator's visual display search.
- Instructions provided for use and fault detection for communications equipment.



**SUBCLASS 88**

The

1. User  
glow
2. Envl
3. Open

## INDEX TO DETAILED

[illegible]



---

**AIR**

1. User conditions - body size, clothing and encumbrances (flight suit, helmet, gloves);
2. Environmental conditions - weather, lighting and climate;
3. Operational conditions - time critical operations (emergency egress).

## INDEX TO DETAILED DESIGN CONSIDERATIONS

[illegible]



## TEST ITEM COMPONENTS

### HUMAN FACTORS CONSULTATIONS

#### A LOCATION & ARRANGEMENT

The positioning of a component as it affects the ability of the operator to reach, operate or manipulate it, including location of openings (accesses), cover or door operation, location of components (knobs, levers, etc.) as well as its relationship to other components.

#### B SIZE & SHAPE

The maximum and/or minimum dimensions of components that are required for adequate man use, including the effects of anthropometric and special clothing (arctic, NBC) considerations, and the shape and contour of handles, knobs and other controls to enhance both the identification and use of the component.

#### C DIRECTION & FORCE

The movement and/or force required to operate or generally manipulate a component (handle, control, fastener, etc.), with emphasis on the direction of motion corresponding to the display, component, total item reaction or standard practice as well as the minimum strength required.

#### D CLEARANCE

The unobstructed space surrounding a component which allows the operator to perform required actions, the adequacy of which varies as a function of the amount of body involved (hand, fingers, arm, torso, etc.) and, where appropriate, will also include considerations such as gloves, boots, helmets, protective clothing, etc.

#### E VISIBILITY

Those aspects of a component that contribute to the operator's ability to see it clearly, including location, size, shape, color, contrast, field of view, viewing distance, reflectance, and illumination.

#### F USE CONDITIONS

Those aspects of a component that pertain to its operational status before, during and after use, as well as the maintenance of an acceptable environment in the workspace areas.

#### G SAFETY

Those aspects of a component that could cause injury to the operator or other personnel, including preventive aspects for bad weather or reduced visibility, accidental contact with electrical, temperature, chemical, radiation and pressurization hazards, and danger to sight and hearing, particularly under the conditions of alert or battle stress.

#### H OPERATING PROCEDURES

Those operational and informational aspects affecting or improving man performance as found in equipment design handbooks as well as job aids, checklists, training texts, troubleshooting guides and repair manuals with specific attention to the safety aspects when using the components.

## 1 LABELS, MANUALS, MARKINGS

Provide technical guidance in the form of written material, schematics, diagrams, illustrations and instruction plates.  
Make operator aware of hazards.  
Give special guidance or instructions.

- Controls, displays, etc. are clearly, appropriately labeled except where use is obvious.
- Labels placed on or near items they identify.
- Do not cover other information.
- Label is not behind control.
- Label location consistent.
- ID labels not obscured by components on flat surfaces on main chassis; min coverage by grime; not easily removed.
- Data groups have the content designated by a title.
- Character height determined by distance read, luminance: FIG 1.B.1.
- Group label characters larger than those of controls, displays which are larger than control, display position characters each by 25% min.
- Letter, numeral styles: FIG 1.B.2-4.
- Height/width ratio:  $5/31$  "h" is 1 stroke width wider; "M" & "W" h/w =  $5/16$ ; "I" & "l" are 1 stroke width.
- Stroke width for black (white) characters on light (black) background:  $1/6$  (1/7-1/8) of height.

- Spacing between characters (word) one stroke (character) width min.
- Line spacings & character height.
- Counter numeral h/w ratio = 1:1 (except 1); separation =  $5/16$  h/w.
- Optical projections all caps, stroke width  $1/6$  to  $1/8$  h/w exceeds 15 minutes visual angle.
- Thumbwheel numeral h/w ratio =  $3/2$ ; h =  $5/16$ ; stroke width internally (externally) illuminated = 1:1 (5:1).
- Abbreviations all caps, no periods.
- Extended copy uses lower case.
- Label characteristics determined by illumination level, color.
- Labels easily, accurately read at operational reading distance, vibration, light levels, environmental conditions.
- Labels are sharp with high or color contrast.
- With illumination above 1 ft-cd black letters, light background.
- Dark adaptation letters visible, do not interfere with night vision.
- Chart readings: FIG 1.B.3.
- Label characteristics accuracy required: time available; distances; light level; color; criticality of function; consistency of design.
- Labels on production equipment are as durable as the equipment.
- Labels for prototype equipment easily affixed, altered, removed.
- Labels not covered by other units nor obscured by grease, dirt.
- Markings, tags are as permanent, washable as equipment.
- Human numerals avoided.
- Vertical labels used only when labels are not critical for personnel safety performance.
- Electrical receptacles marked with voltage, phase, frequency.
- Warning placards illuminated.
- Placards adjacent to hazards.

- Abbreviations are standard (MIL-STD-121) new OK if obvious.
- Aircraft station labeling legends: FIG 1.H.1-3.
- Trade names, irrelevant info do not appear on labeling.
- Labels concise; min redundancy.
- Abstract symbol only if meaningful.
- Words familiar to user.
- Hand grasp areas identified.
- Axes of graphs labeled and graduated appropriately.

## 2 STEPS, LADDERS, PLATFORMS

Provide a surface to accommodate user's feet while climbing or conducting routine checks and for the temporary placement of loads.  
Wheels, hubs and structural members used for climbing are evaluated as ladders.  
Angle of ascent definitions: ladders,  $75^{\circ}$ - $90^{\circ}$ ; stair ladders,  $50^{\circ}$ - $75^{\circ}$ ; stairs,  $20^{\circ}$ - $50^{\circ}$ ; ramps,  $0^{\circ}$ - $20^{\circ}$ ; platforms,  $0^{\circ}$ .

- Adequate footholds provided for crew to reach hatches from ground.
- Sequence of stepping points ends with proper man orientation to door or entryways.
- Step surfaces within, without workspace easily reached from either direction.

- Gross (limiting) dimensions based on 95th% (5th%) body dimensions of users: FIG 2.B.1-7.
- Stair, stair-ladder, fixed-ladder dimensions do not exceed the max. min dimensions: FIG 2.B.1-3.
- Stairs, ladders accommodate 5th-95th% user wearing arctic clothing: FIG 2.B.8.

- Folding ladder lift heights 9' max.
- One man limits to lift, store ladders 9' for 20 lb & for 25 lb.
- Stairs, ladders, platforms, ramps withstand heaviest combined weight of user plus equipment plus safety factor.

- Finger clearance is provided in folding steps, ladders.
- Step width, spacing accommodate boots: FIG 2.B.8.
- Folding ladder catches, locks operable with cold/wet arctic mittens: FIG 2.B.11.

- Visual obstructions, blind footholds avoided.
- Treads contrast with structure, conspicuous in dim light.

- Stair-ladders are of metal with the tread rise open at rear.
- Suitable footholds supplied.

- Ladders are not provided when equipment is to be hand carried.
- Ladders, stairs non-slip surface.
- Step openings safety bars, chains.
- Obstructions, sharp edges are ped-

- Footholds marked, identified.
- "No Step" markings if applicable.
- Warnings labels for hazards.
- Procedures listed for stowing, emptying ladders, ramps.

## 3 HANDHOLDS, HANDLES

Assist users to mount and enter the item and to maintain balance.  
Supply leverage and support to a climbing or working man.  
Door handles, structural members, etc., used for gripping or balance, are evaluated as handholds.

- Adequate hand grips provided for crew to reach hatch from ground.
- Handholds furnished where needed within easy reach.
- Handholds integrated with doors, entry ways for stability.
- Adequate handholds for balance while moving.

- Handrail dimensions: FIG 2.B.1-3.
- Handhold lengths: 6" min.
- Handhold openings: 6" x 4" min.
- Shaped handholds improve grip.

- Handholds do not intrude into workspace.
- Handhold accommodations: arctic gloves: FIG 2.B.11.
- Handholds clearly visible from inside and out prior to grasping.
- Color coded to enhance visibility, prevent grasping error.

- Suitable handholds supplied.
- Handholds provided to aid escape.
- Handholds useable with gloves.
- Handgrip useable with bare hands in hot climates, high temps.
- Collapsible handholds useable while wearing arctic mittens.

- Handholds have non-slip surfaces.
- Handrail height: 36" above walking surface.
- Handgrip areas away from cables, lines, hot pipes, other hazards.
- Inappropriate structures, wires cannot be used as handholds.

- Handholds marked, identified.

## 4 DOORS, HATCHES, PASSAGES

Provide a means for entering and leaving the enclosure.  
Provide openings for loading or unloading material.  
Components are evaluated for both normal and emergency use.  
Some doors serve dual purposes and must also be evaluated as steps, ramps or platforms.

- Wall hatches flush with floor where structurally possible.
- Latch handle placement is uniform throughout vehicle.
- Latch handles can be reached from normal approach positions.
- Handgrips, footsteps help user reach hatch easily.
- Overhead hatches latch to hold open inside readily 1 hand operation.
- Handles can be reached, operated by troops in bulk clothing.
- Rectangular hatch, passageways: 26" x 30" h min.
- Circular hatch, tunnels: 30" dia min.

- Hatch handle unlatching forces: 20 lb max.
- Overhead hatch opening force, 50 lb max operable by user with 5th% arm, hand strength: FIG 6.C.1.
- Emergency exit release handles: 30lb max force; 2 separate motions max.
- Hatch opening forces: 50 lb max.
- Handles operable with gloves.

- Fixed equipment is located 3" min from exact area of doors.
- Gross (limiting) dimensions based on 95th% (5th%) fully equipped users: FIG 2.B.1-7.
- Tunnels permit passage of user with equipment, clothing.
- Handles, handgrips useable with arctic mittens: FIG 2.B.11.
- Entry, egress possible wearing boots.

- Exits identifiable in dim light.
- Emergency lights at each exit, self contained power, automatic & commander operated, removable for emergencies.
- Latch control visible initially.
- Door jamb or opening height allows full view of step point.
- "See thru" where possible.

- Doors: minimum jamming.
- Doors, hatches: quick opening, easily opened, standard latch handle operation throughout.
- Escape exits do not open inadvertently, handles are not lock-wired.
- Passage clearances: min 24" free up.
- Latch handles do not freeze up.

- Doors, emergency exits are easily reached, unobstructed, quick opening: 3 sec max.
- Hatches over 72" above ground have evacuation slide slides, poles, ladders, ropes.
- Ropes at evacuation slide stand off from structure to permit use by more than one person at a time.
- Escape openings smooth-edged, no obstructions, permit passage with survival equipment.
- Glass in doors shatterproof.
- Exit instructions are legible, brief, clearly worded.
- Latch handle motion marked.
- Emergency evacuation: completed within 60 seconds using 1/2 exits.

- Doors, emergency exits are easily reached, unobstructed, quick opening: 3 sec max.
- Hatches over 72" above ground have evacuation slide slides, poles, ladders, ropes.
- Ropes at evacuation slide stand off from structure to permit use by more than one person at a time.
- Escape openings smooth-edged, no obstructions, permit passage with survival equipment.
- Glass in doors shatterproof.
- Exit instructions are legible, brief, clearly worded.
- Latch handle motion marked.
- Emergency evacuation: completed within 60 seconds using 1/2 exits.

## 6 CONTROLS

Components used to effect actions.  
Handles, grips, knobs.  
Controls are evaluated as follows:

- Control relationship: apparent, compatible.
- Functionally related grouped together.
- Control groups, sections have left-to-right to bottom order of use.
- Controls in function located in accordance with sequence and direction of use.
- Controls oriented to a.
- Can not accidentally be.
- Recurring groups similar.
- Rotary size, shape: 1:1.
- Linear size, shape: 1:1.
- Controls have non-slip.
- Gross (limiting) dimensions based on 95th% (5th%) operator.
- Size coding: 3 sizes min.

- Isometric joystick: 4.2-7.1" grip diameter.
- Isometric joystick: for integral switches finger-actuated.
- Adequate control response.
- Conventional control: FIG 6.C.3.
- Isometric joystick: full output not to exert.
- Peaks return to zero after use.
- Rotary valves open 90°.
- Forces, displacement: mechanical controls: F1.
- Free from backlash.
- Avoid the requirement force on joystick.
- Control spacing: min. blind operation: 5" min.
- Rotary operation: F1.
- Linear operation: F1.
- Compatible with hand.
- Foot switches separate.
- Display interface: min. 8" vertical min.
- Range of control: no interference with other controls.
- Larger diameter controls used for the fine adj.
- Shape coded controls: easily identifiable.
- Color coding: 5, 10, 15.
- Ambient light color: de-able control colors.
- Reference line has 50% with control color.
- Pointer parallel error: 25% max.
- Thumbwheel: interval: ambient illumination: 10 ft-cd.
- Thumbwheel: readable: 10 ft-cd.
- Legend switch legend.
- Precision of control consistent with that of selected, distributed user's limbs are over 10" variable g-loading on.
- Coding uniform three-ary.
- Useable in time re: inadvertent operation.
- Controls not adverse: distraction, shock, vibration.
- Movement oriented: 1:1.
- Several sections are use: System response times.
- Shape coding free of: to accidental movement.
- Controls that initiate operations require prior locking control.
- Main power ON-OFF: power to equipment.
- Emergency controls related warning a hand.
- Compatible with hands.

- Isometric joystick: 4.2-7.1" grip diameter.
- Isometric joystick: for integral switches finger-actuated.
- Adequate control response.
- Conventional control: FIG 6.C.3.
- Isometric joystick: full output not to exert.
- Peaks return to zero after use.
- Rotary valves open 90°.
- Forces, displacement: mechanical controls: F1.
- Free from backlash.
- Avoid the requirement force on joystick.
- Control spacing: min. blind operation: 5" min.
- Rotary operation: F1.
- Linear operation: F1.
- Compatible with hand.
- Foot switches separate.
- Display interface: min. 8" vertical min.
- Range of control: no interference with other controls.
- Larger diameter controls used for the fine adj.
- Shape coded controls: easily identifiable.
- Color coding: 5, 10, 15.
- Ambient light color: de-able control colors.
- Reference line has 50% with control color.
- Pointer parallel error: 25% max.
- Thumbwheel: interval: ambient illumination: 10 ft-cd.
- Thumbwheel: readable: 10 ft-cd.
- Legend switch legend.
- Precision of control consistent with that of selected, distributed user's limbs are over 10" variable g-loading on.
- Coding uniform three-ary.
- Useable in time re: inadvertent operation.
- Controls not adverse: distraction, shock, vibration.
- Movement oriented: 1:1.
- Several sections are use: System response times.
- Shape coding free of: to accidental movement.
- Controls that initiate operations require prior locking control.
- Main power ON-OFF: power to equipment.
- Emergency controls related warning a hand.
- Compatible with hands.

- Isometric joystick: 4.2-7.1" grip diameter.
- Isometric joystick: for integral switches finger-actuated.
- Adequate control response.
- Conventional control: FIG 6.C.3.
- Isometric joystick: full output not to exert.
- Peaks return to zero after use.
- Rotary valves open 90°.
- Forces, displacement: mechanical controls: F1.
- Free from backlash.
- Avoid the requirement force on joystick.
- Control spacing: min. blind operation: 5" min.
- Rotary operation: F1.
- Linear operation: F1.
- Compatible with hand.
- Foot switches separate.
- Display interface: min. 8" vertical min.
- Range of control: no interference with other controls.
- Larger diameter controls used for the fine adj.
- Shape coded controls: easily identifiable.
- Color coding: 5, 10, 15.
- Ambient light color: de-able control colors.
- Reference line has 50% with control color.
- Pointer parallel error: 25% max.
- Thumbwheel: interval: ambient illumination: 10 ft-cd.
- Thumbwheel: readable: 10 ft-cd.
- Legend switch legend.
- Precision of control consistent with that of selected, distributed user's limbs are over 10" variable g-loading on.
- Coding uniform three-ary.
- Useable in time re: inadvertent operation.
- Controls not adverse: distraction, shock, vibration.
- Movement oriented: 1:1.
- Several sections are use: System response times.
- Shape coding free of: to accidental movement.
- Controls that initiate operations require prior locking control.
- Main power ON-OFF: power to equipment.
- Emergency controls related warning a hand.
- Compatible with hands.

- Isometric joystick: 4.2-7.1" grip diameter.
- Isometric joystick: for integral switches finger-actuated.
- Adequate control response.
- Conventional control: FIG 6.C.3.
- Isometric joystick: full output not to exert.
- Peaks return to zero after use.
- Rotary valves open 90°.
- Forces, displacement: mechanical controls: F1.
- Free from backlash.
- Avoid the requirement force on joystick.
- Control spacing: min. blind operation: 5" min.
- Rotary operation: F1.
- Linear operation: F1.
- Compatible with hand.
- Foot switches separate.
- Display interface: min. 8" vertical min.
- Range of control: no interference with other controls.
- Larger diameter controls used for the fine adj.
- Shape coded controls: easily identifiable.
- Color coding: 5, 10, 15.
- Ambient light color: de-able control colors.
- Reference line has 50% with control color.
- Pointer parallel error: 25% max.
- Thumbwheel: interval: ambient illumination: 10 ft-cd.
- Thumbwheel: readable: 10 ft-cd.
- Legend switch legend.
- Precision of control consistent with that of selected, distributed user's limbs are over 10" variable g-loading on.
- Coding uniform three-ary.
- Useable in time re: inadvertent operation.
- Controls not adverse: distraction, shock, vibration.
- Movement oriented: 1:1.
- Several sections are use: System response times.
- Shape coding free of: to accidental movement.
- Controls that initiate operations require prior locking control.
- Main power ON-OFF: power to equipment.
- Emergency controls related warning a hand.
- Compatible with hands.

- Isometric joystick: 4.2-7.1" grip diameter.
- Isometric joystick: for integral switches finger-actuated.
- Adequate control response.
- Conventional control: FIG 6.C.3.
- Isometric joystick: full output not to exert.
- Peaks return to zero after use.
- Rotary valves open 90°.
- Forces, displacement: mechanical controls: F1.
- Free from backlash.
- Avoid the requirement force on joystick.
- Control spacing: min. blind operation: 5" min.
- Rotary operation: F1.
- Linear operation: F1.
- Compatible with hand.
- Foot switches separate.
- Display interface: min. 8" vertical min.
- Range of control: no interference with other controls.
- Larger diameter controls used for the fine adj.
- Shape coded controls: easily identifiable.
- Color coding: 5, 10, 15.
- Ambient light color: de-able control colors.
- Reference line has 50% with control color.
- Pointer parallel error: 25% max.
- Thumbwheel: interval: ambient illumination: 10 ft-cd.
- Thumbwheel: readable: 10 ft-cd.
- Legend switch legend.
- Precision of control consistent with that of selected, distributed user's limbs are over 10" variable g-loading on.
- Coding uniform three-ary.
- Useable in time re: inadvertent operation.
- Controls not adverse: distraction, shock, vibration.
- Movement oriented: 1:1.
- Several sections are use: System response times.
- Shape coding free of: to accidental movement.
- Controls that initiate operations require prior locking control.
- Main power ON-OFF: power to equipment.
- Emergency controls related warning a hand.
- Compatible with hands.

- Isometric joystick: 4.2-7.1" grip diameter.
- Isometric joystick: for integral switches finger-actuated.
- Adequate control response.
- Conventional control: FIG 6.C.3.
- Isometric joystick: full output not to exert.
- Peaks return to zero after use.
- Rotary valves open 90°.
- Forces, displacement: mechanical controls: F1.
- Free from backlash.
- Avoid the requirement force on joystick.
- Control spacing: min. blind operation: 5" min.
- Rotary operation: F1.
- Linear operation: F1.
- Compatible with hand.
- Foot switches separate.
- Display interface: min. 8" vertical min.
- Range of control: no interference with other controls.
- Larger diameter controls used for the fine adj.
- Shape coded controls: easily identifiable.
- Color coding: 5, 10, 15.
- Ambient light color: de-able control colors.
- Reference line has 50% with control color.
- Pointer parallel error: 25% max.
- Thumbwheel: interval: ambient illumination: 10 ft-cd.
- Thumbwheel: readable: 10 ft-cd.
- Legend switch legend.
- Precision of control consistent with that of selected, distributed user's limbs are over 10" variable g-loading on.
- Coding uniform three-ary.
- Useable in time re: inadvertent operation.
- Controls not adverse: distraction, shock, vibration.
- Movement oriented: 1:1.
- Several sections are use: System response times.
- Shape coding free of: to accidental movement.
- Controls that initiate operations require prior locking control.
- Main power ON-OFF: power to equipment.
- Emergency controls related warning a hand.
- Compatible with hands.



#### 4 DOORS, HATCHES, PASSAGES

- Provide a means for entering and leaving the workspace.
- Provide openings for loading or unloading material.
- Components are evaluated for both normal and emergency use.
- Some doors serve dual purposes and must also be evaluated as steps, ramps or platforms.

#### 6 CONTROLS

Components used to activate, deactivate and modify the equipment power and to modulate the operating elements.

Handles, grips, levers, switches, triggers, levers, wheels, pedals and other man-operated items as applicable.

Controls are associated only with the item under test, not with equipment placed on it.

#### 7 SPECIAL CONTROLS

Particular components, used only on specific equipment, which are in addition to the normal complement of controls or controllers.

#### 8 DISPLAYS

Components that provide position information. Displays are associated with controls.

- Wall hatches flush with floor where structurally possible.
- Latch handle placement is uniform throughout vehicle.
- Latch handles can be reached from normal approach positions.
- Handgrips, footsteps help user reach latch easily.
- Overhead hatches latch to hold open inside packing hand operation.
- Handles can be reached, operated by troops in bulky clothing.
- Rectangular hatch, passageway: 26" w, 30" h min.
- Circular hatch, tunnel: 30" dia min.

- Hatch handle unlatching force: 20 lb max.
- Overhead hatch opening force, 50 lb max; operable by user with 50% arm, hand strength FIG 6.B.1-8.
- Emergency exit release handles: 30 lb max force; 2 separate motions max.
- Hatch opening force: 50 lb max.
- Handles operable with gloves.

- Fixed equipment is located 3" min from panel area of doors.
- Gross (limiting) dimensions based on 50th (50th) fully equipped user FIG 7.D.1-7.
- Tunnels permit passage of user with equipment, clothing.
- Handles, handgrips useable with arctic mitts FIG 7.B.1-1.
- Entry, egress possible wearing boots.

- Exists identifiable in dim light.
- Emergency light: at each exit, self contained power, automatic & commander operated, removable for emergencies.
- Latch control visible initially.
- Door jamb or coming height allows full view of step point.
- "See thru" where possible.

- Doors: minimum jamming.
- Doors, hatches: quick opening, easily operated, standard latch handle operation throughout.
- Escape exits: do not open inadvertently, handles are not lock-wired.
- Passage floors non-slip.
- Latch handles do not freeze up.

- Doors, emergency exits are easily reached, unobstructed, quick opening, 3 sec max.
- Hatches over 72" above ground have evacuation aids: slides, poles, ladders, ropes.
- Ropes as evacuation aids stand off from structure to permit use by more than one person at a time.
- Escape openings smooth-edged, no obstructions, permit passage with survival equipment.
- Glass in doors shatterproof.
- Exit instructions are legible, brief, clearly marked.
- Latch handle motion marked.
- Emergency evacuation completed within 60 seconds using 1/2 exits.

- Control relationship to its display is apparent, compatible.
- Functionally related controls are grouped together.
- Control groups, sequential operations have left-to-right and/or top-to-bottom order of use.
- Controls in functional groups are located in accordance with operational sequence and/or function.
- Controls oriented to operator.
- Can not accidentally be moved.
- Recurring groups similar thru system.
- Rotary size, shape: 1 1/2" 6.A.1-8.
- Linear size, shape: FIG 6.B.5-18.
- Controls have non-slip surfaces.
- Gross (limiting) (adjustable) dimensions based on 95th% (5th%) (5-75th%) operator.
- Size coding: 3 sizes max.

- Isometric joystick: shaft length: 4.3-7.1", grip diameter: 2".
- Isometric joystick: hand-grip for integral switching otherwise finger-grip.
- Only 1 switch per foot (preferred).
- Display interface: controllers size, shape: FIG 6.B.17-19.
- Mixture controls used only under space constraint; size and separation maximum.

- Fast-operated control user force needed greater than upper body muscular, frequent operations; alternative shutdown control.
- F/D ratios: large (small) for small (large) range of display movement.
- Switches: No stop between positions; resistance increases until snap into position.
- Display interface controllers force, displacement: FIG 6.B.19-21.

- Rotary separations: FIG 6.B.1-8.
- Rotary separations: FIG 6.B.1-8.
- Linear separations: FIG 6.B.5-18.
- Compatible with handwear used.
- Control switches separated 3" horizontally, 1" vertically minimum.
- Display interface controllers clearance: FIG 6.B.17-19.
- Range of control action does not interfere with other controls.
- Larger diameter concentric control is used for the fine adjustment.
- Shape coded controls visually, tactually identifiable.
- Color contrasts with background.
- Ambient light color determines useable control colors.
- Reference line has 50% min contrast with control color.
- Pointer parallel error between reference marker 25% min.
- Threshold: Internally lighted if ambient illumination below 1 ft-c.
- Threshold: readable 30" off-axis.
- Legend switch legend is legible.
- Precision of control manipulation is consistent with that of system.
- Selected, distributed so none of user's limbs are overburdened.
- Variable g-loading considered.
- Coding uniform throughout system.
- Usable in time required despite inoperative operation protection.
- Controls not adversely affected by vibration, shock, vibration.
- Movement oriented to operator if several stations are used.
- System response time: FIG 6.F.2.

- Shape coding free of sharp edges.
- Critical controls are not susceptible to accidental movement.
- Controls that initiate hazardous operations require prior operation of a locking control.
- Main power ON-OFF switch out of reach to crewman.
- Emergency controls located near related warning display/nearest hand.
- Compatible with handwear used.

- Minimum decoding required.
- Control color related to display.
- Operating instructions provided except where use is obvious.
- Diagrams used where possible.
- Main power switch labeled.
- If red lighting is used, red is not used for coding use yellow and black striping instead.
- Emergency (noncritical) functional groups outlined with 3/16" red (1/16" black) border.

- Keyboard arrangement, number of keys compatible with info to be entered.
- Feet rest provided for pedal angle over 20°.
- Pedals reached easily.
- Standardization of keyboard's within system.
- Keyboards conform to MIL-STD-128B.

- Isometric joystick: shaft length: 4.3-7.1", grip diameter: 2".
- Isometric joystick: hand-grip for integral switching otherwise finger-grip.
- Only 1 switch per foot (preferred).
- Display interface: controllers size, shape: FIG 6.B.17-19.
- Mixture controls used only under space constraint; size and separation maximum.

- Fast-operated control user force needed greater than upper body muscular, frequent operations; alternative shutdown control.
- F/D ratios: large (small) for small (large) range of display movement.
- Switches: No stop between positions; resistance increases until snap into position.
- Display interface controllers force, displacement: FIG 6.B.19-21.

- Rotary separations: FIG 6.B.1-8.
- Rotary separations: FIG 6.B.1-8.
- Linear separations: FIG 6.B.5-18.
- Display interface controllers clearance: FIG 6.B.17-19.

- Pointers differentiated for each level of ganged set.
- Interface controllers: in case control applications, indicators provided to facilitate returning followers to display.
- Display frames and pages uniquely identified.

- Isometric joystick use visual feedback, minimal delay tight coupling of input/output; return to center after user requirement.
- Isometric joystick drive between control movement and display response: 1 sec max.
- In bracketing, knobs swing thru 10-70° are around target value.
- Lighters have feedback of placement, actuation, and input reception.

- Emergency controls located near related warning display/nearest hand.
- Fast-operated switches located away from obstructions.
- Recommended manual controls: FIG 6.F.1.
- Data manipulated without concern for internal storage.

- Erroneous entries are easily corrected.
- Internal software checks minimize user errors.
- Critical entries require user acknowledgment; can be edited.
- Control inputs result in positive response displayed to indicate performance.
- User chooses sequence of transaction.
- Data entry requires explicit completion action; requires pace by user.

- Forces, displacements (including miniature controls) FIG 6.B.1-21.
- Stops at beginning and end of control active positions.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: deflection minimal, perceptible.

- Recommended manual controls: FIG 6.F.1.
- Lightpad have discrete activating mechanism.
- Variable function keys have a visual signal if standard function unavailable.
- Fixed function keys used for critical or frequent inputs.
- Cursor control is consistent with speed and accuracy requirements.

- Fixed wing cockpit control locations: FIG 7.A.1-2.
- Rotary wing cockpit control locations: FIG 7.A.3-5.
- Aircraft controls are operable with shoulder harness locked.

- Gross, (limiting) (adjustable) dimensions based on 95th% (5th%) (5-75th%) operator: FIG 7.D.1-7.

- Overhead switches are actuated upward (forward) for increased performance if overhead panel is in an angle of 0-30° (30-90°) to vertical axis.
- Fixed wing control actuation: FIG 7.C.1.
- Rotary wing control actuation: FIG 7.C.2.
- Primary, curtain (alternat., D-ring) ejection control force: extract, 20-40 (15-25) lbs; fire 30-40 (30-40) lbs.

- Pitch, roll control clearances: FIG 7.D.1-2.
- Yaw control clearances: FIG 7.D.3.
- Single, multiple throttle controls: FIG 7.D.4; except multiple is based on forward most position of throttle furthest from crewman.
- Collective controls: FIG 7.D.5.
- Controls, switches, control guards & covers operable by gloved hand.

- Emergency controls have yellow & black stripes or background.
- Emergency control colors limited to grey, black, white, yellow.

- Landing gear lock, release is operable by hand or foot.
- Firing mechanism for ejection seats is located, protected to preclude inadvertent actuation.

- Rotary wing aircraft have no emergency control that requires the removal of the pilot's right hand from the cyclic stick.
- Actuation of controls, switches involving flight safety are consistent with previous models of the particular aircraft.
- Ejection controls do not jeopardize user's safety nor hinder emergency escape.
- Ejection controls operable by 3rd - 90th crewman.
- Printed instructions in the cockpit are minimized, legible.
- Cockpit information displays: Lettering, numbering, markings, symbols on displays, controls, control panels; emergency procedures for exiting, ditching flight, operational procedures; radio call signs.

- Display relationship to parent; determines control equipment displayed.
- Displays, groups have and/or top-to-bottom or left-to-right order.
- Displays located so they are in the required degree of view.
- Positions of related displays on separate panels.
- Display positions correct relative to equipment motion.
- Lighted control indicators unambiguously associated with equipment motion.
- Pointer extends to but is not secure or exceed index mark.
- Pointers are close to a note parallel, shadows.
- CRT target visual angle: minutes, 10 lines of resolution: 16" (10" min).
- Counters, flags, printers: FIG 8.B.1.
- Circular dials: FIG 8.B.1.

- Design Requirements (MIL-STD-172)
- User-Computer Interface (MIL-STD-172)
- Guidance Data (MIL-HDBK-759)

- Display face to line of sight: 45° min parallel, reflex.
- Frequently used displays optimal visual zones: FIG 7.D.1-7.
- Illumination uniform: FIG 7.D.1-7.
- Indicator lights show no springing, visible.
- Contrast, luminance: 3-5 fcd.
- Flashing lights: 3-5 fcd.
- Color coding used with unaltered scales covered.
- Flashing lights: synchronous, LED's red only; dimming.
- Display precision, consistent with that of system.
- Information displayed: precise, readable; not degraded by vibration.
- Lights show functions: 1-5.
- Scales: linear, start at numbers, 2 pointers oriented upright.
- Mechanical types: FIG 7.D.1-7.
- Audio signal evaluation.
- Audio, verbal warnings: clear background.
- Failure immediately on signal absence does not indicate light color: FIG 8.F.1; master light.
- Audio warnings: transmitters and work are.
- Audio signal action reflects nature of problem.
- Prohibited, persistent: FIG 8.G.1.
- Audio warning duration: 3 sec; will corrective action.
- Minimum decoding required.
- Trademarks, irrelevants etc do not appear on panels.
- Coding techniques: unambiguous, relationship, criticality.
- Auxiliary displays: use overburdened, display undesirable warning, etc.
- Verbal warnings: intelligible.
- Audio warnings: use standard.
- Labels: functional; but not graduated in size.



**CONTROLS**

Components, used only on equipment, which are in additional complement of controls.

**8 DISPLAYS**

Components that provide visual and auditory information to the operator concerning the status of operation. Provide positive indication of developing or current malfunctions. Displays are associated only with the item under test, not with equipment placed in or on it.

**9 SPECIAL DISPLAYS**

Particular Components, used only on specific equipment, which are in addition to the normal complement of the usual displays.

**10 WORKSPACE**

The area within which the user operates the equipment. Includes space for controls, displays, optics, electronic devices, weapons and windows as well as standing areas, consoles and seats. Provides storage for excess clothing, personal gear, weapons and tools. Protects operator from adverse environment, when applicable.

cockpit control loca-  
A.1-2.  
cockpit control loca-  
S.  
Controls are operable with  
less locked.

ing (adjustable) de-  
on 95th% (5th%) (15-  
start 25.0-1-7.

ches are actuated (up-  
d) for increased per-  
overhead panel forms an  
0° (30-90°) to vertical

ontrol actuation: FIG.

ontrol actuation: FIG.

tain (alternate, 13-19)  
ontrol forces extract, 20-  
; fire 30-40 (30-40) lbs.

ontrol clearances: FIG.

clearances FIG 7.D.5.  
ple throttle control:  
cept multiple is based  
st position of throttle  
-crewmans  
nitrols FIG 7.D.5.  
ches, control guards A  
le by gloved hand.

ontrols have yellow A  
or background,  
ontrol colors limited to  
white, yellow.

lack, release is oper-  
or fast,  
anism for ejection seats  
ected to preclude in-  
-mation.

ircraft have no emer-  
-l that requires the op-  
-rator's right hand from  
-le.  
controls, switches in-  
-safety are consistent  
-models of the particu-  
-lar.

ontrols do not jeopardize  
nor hinder emergency  
-ontrols.

ontrols operable by 3rd  
-man.  
-functions in the cockpit  
-d, lighted,  
-mation displayed: Let-  
-tering, markings, sym-  
-bols, controls, control  
-rmy procedure's for  
-ing flight, operational  
-dio call signs.

- Display relationship to control is apparent; determines control used, equipment displayed.
- Displays, groups have left-to-right and/or top-to-bottom order of use.
- Displays located so they can be read to the required degree of accuracy.
- Positions of related controls, displays on separate panels correspond.
- Display positions correspond to positions of equipment monitored.
- Lighted control indicators are unambiguously associated with controls.
- Display viewing distances 13-28".
- Pointers extend to but does not obscure or extend index mark width.
- Pointers are close to dial to eliminate parallax, shadows.
- OTI target visual angle exceeds 2.0 minutes, 10 lines of resolution distance 16" (10" min).
- Counters, flags, printers, plotters: FIG 8.B.1.
- Circular dials: FIG 8.F.X.

• Design Requirements (MIL-STD-1472)

• User-Computer Interface Data (MIL-STD-1472C)

• Guidance Data (MIL-HDBK-759, Etc.)

- Display face to line of sight exceeds 45° min parallax, reflection.
- Frequently used displays grouped in optimal visual zones: FIG 8.E.1.
- Illumination uniform: FIG 8.E.3.
- Indicator lights show response, used sparingly, visible.
- Contrast, luminance exceeds 50%.
- Flashing lights: 3-5 flashes/sec.
- Color coding used where possible; unused scales covered.
- Flashing lights synchronized.
- LEDs red only; dimming compatible.
- Display precision, response is consistent with that of system.
- Information displayed: Clear, specific, precise, unambiguous, not redundant, degraded by vibrations timely.
- Lights show functions: FIG 8.F.1.
- Scales: linear, start at 0, use whole numbers, 2 pointers max, numerals oriented upright.
- Mechanical types: FIG 8.F.2.
- Audio signal evaluations: FIG 8.F.3.
- Audio, verbal warnings: 20 dB min above background.
- Failure immediately apparent.
- Signal absence does not mean "off".
- Indicator light color coding for emergency, warning, summation, etc: FIG 8.F.1; master lights set apart.
- Audio warnings transmitted to both earphones and work area.
- Audio signal action segment specific nature of problem.
- Prohibited, persistent signals are not used: FIG 8.G.1.
- Audio warning durations min of 1 sec until corrective action taken.
- Minimum decoding required.
- Trademarks, irrelevant information, etc do not appear on panel face.
- Coding techniques uniform facilitate discrimination, identification, relationship, criticality.
- Audio displays used where vision overburdened, degraded, redundancy desirable; warning, cue needed.
- Verbal warnings intelligible, apt.
- Audio warnings use standard signals.
- Labels: functionally basic; well located; graduated in size.

- Display pointers are aligned for common stable values.
- Recurring tabular data is similarly located.
- Tabular data is displayed left-to-right, top-to-bottom.
- All data needed to support activity is grouped together.
- Simple menus used when all selections fit on 1 page.
- For hierarchical menus a direct function call capability is provided.

- Information necessary for selection of control action available when needed.
- Tabular displays used to present row-column data.
- Information density held to minimum on critical task displays.
- Standardized data fields used.
- Information displayed limited to that necessary to make decisions.

- Illumination balanced full on to off.
- Display changes represent functional state.
- Digital values requiring reliable reading updated 1 per second or less.
- Color or rate of change values updated between 2 and 5 per second.
- Graphic displays requiring interpretation of rapidly changing patterns updated consistent with the user's information handling rate.

- Priority information obvious.
- Circular dials: FIG 8.B.2.
- Data entered via keyboard are displayed, as keyed, on the screen.
- Mechanical overlays for keyboards, displays are avoided.
- Displays are designed for the expected operational environment.
- Expected use of information determines update rates.
- Display formats designed to optimize information transfer.

- Auditory displays volume adjustable.
- Internally detected error messages explicit, neutral in tone.
- Prompt and structuring features available for interactive sessions and error location.
- Nomenclature approved by procuring agency.
- Abbreviations from MIL-STD-12, MIL-STD-411, and MIL-STD-781.
- Feedback provided to indicate system status.

- Fixed wing cockpit display locations: FIG 7.A.1-2.
- Rotary wing cockpit display locations: FIG 7.A.3-5.
- Light signals are not within the basic flight instrument group.
- Warning, master caution lights are in the 30° cone of vision.
- Caution lights for single, tandem (side-by-side) aircraft lower right (lower center) of panel.
- Advisory lights visible but are not on main instrument of sub panel.
- Instrument panel location provides 18" clearance for crew member's legs throughout the full range of movement: FIG 7.D.3.
- Caution, warning, advisory light legend markings 1/8-1/4" high.
- HUD exit pupil 2.8"
- HUD field of view: 20° vertical, 20° horizontal.

- Symbol line on 3.6 ± 0.7 minutes (1.7 minutes minimum).

- Symbol brightness, contrast ratio of E/O displays is adjustable, then automatically maintained at the selected level.
- HUD, VSD, HSD symbols visible in 10,000 ft-L ambient illumination.
- Instruments that have glare shields, barrels in plane can be easily read by crew.
- HUD symbol brightness 2,800-3,000 Ft-L.
- HUD contrast ensures legibility.

- Master lights are push-to-restart.
- "Wheels" warning flashes power reduced - flaps extended - wheels up.
- Non-verbal warnings: FIG 9.F.1.
- Verbal warning signals used only to complement usual signals.
- Verbal signals are audible continuous until action is taken.
- Verbal signal structures general headings specific subsystem, location nature of emergency.
- HUD upper simultaneous presentation of critical information with other primary visual aids.
- Warning light signal assembly has opaque lettering on a translucent evasion red background.
- Caution light signal assembly has translucent evasion yellow letters and an opaque background.
- Advisory light signal assembly has translucent evasion green, blue or white letters and an opaque background.
- Operator and maintainer information not combined unless compatible for both users.
- Light signal priority: top-to-bottom, left-to-right.
- Aircraft station warning, caution, advisory legends: FIG 9.F.1-3.
- HUD, VSD, HSD symbols are consistent, unique, fly-by.
- Symbol color coding is permissible, flashing is minimized.
- Moving scales have at least 3 numbers always visible.

- Display placement above standing (seated) surface: normal, 41-70" (6-84th) per se only, frequently read, 50-65" (16-35th), ± 21" from centerline.
- Controls on vertical surface above floor (seated normal, 34-70" (8-34th); previously, frequently used, 34-57" (8-29th), ± 21" from user centerline).
- Seated operator has free access, use of foot pedals.
- Compartment design allows equipment sharing, gear communication.
- User oriented to work site.
- Arm rests 2.8" min.
- Standard console: FIG 10.B.1-3.
- Gross (limiting) dimensions based on 95th % (5th %) fully equipped user: FIG 25.A.1-7. Aerics: FIG 25.B.1.
- Adjustable dimensions fit 5-95th%.
- Aircraft seating, ejection seat geometry: FIG 10.B.4-5.
- Aerobics don't interfere with work, egress, emergency procedures.
- Seats: max protection under g-hat.
- Aircraft seating, ejection seat geometry: FIG 10.B.4.
- Vertical seat adjustment: 15-27" in 1" increments.
- Rotating seats 8 locking positions min, support 250 lbs when serviced. Seat adjusts face, aft: 4° min.
- Operator does not have to lift self to adjust seat.

- Knee room 25x20x48" head min.
- Unusual positions: FIG 10.D.1-3.
- Allowances made for heavy clothing, protective equipment.
- Ejection seats fit 3-98th% personnel wearing applicable equipment.
- Egress clearance adequate.
- Aircraft geometry allows for survival equipment: FIG 10.D.4.
- Unusual positions: FIG 10.D.1-3.
- Workarea anthropometrics: FIG 10.D.1-3.

- Illumination: FIG 10.E.1.
- Transparent areas free from color, distortion, etc.
- Multifunctions from multilayered windows minimized.
- Window area angle of incidence 60° max for undistorted vision.
- Windows, canopies have optimum unobstructed vision.
- Pilot vision plane: FIG 10.E.2.
- Indirect reflecting pilot able to see horizon, signals, enemy probe.
- Instrument reflection avoided.
- Acoustical environment does not degrade system effectiveness.
- Noise levels: FIG 10.F.2-8.
- Whole body vibration limits: X, Y, Z, time: FIG 10.F.9.
- Crew ops in variable g restraint, locomotion aids standing limited.
- Ejection raises: FIG 10.F.10.
- Ejection systems controls accessible; limits, head restraint adequate; life support provided.
- Compartment adapted to crew use.

- Exposure to gases, fumes, toxicity: see THRESHOLD LIMIT VALUES.
- Input rate: FIG 10.G.1.
- Noise duration limits: FIG 10.G.3.
- Hazard clearing device provided.
- Exposed edges (corners) rounded: 0.04" (0.57) min radius.
- Vehicle escape simple, effective within 30-60 sec.
- Ejection system usable throughout flight envelope.
- Accidental ejection minimized.
- Material ejection limits: FIG 10.G.4.
- Adequate, suitable storage for manuals, worksheets, etc.
- Conspicuous placards adjacent to equipment hazardous to user.
- Areas requiring special equipment, clothing are specifically identified.
- Structures can be chopped thru in emergencies is clearly marked; areas provided, labeled.
- Emergency procedures detailed.
- Instructions kept simple.
- Seat adjustment diagrammed.
- Push-out escape windows marked.



TEST FUNCTION

TEST ITEM CLASS I

SUBCLASS C

**OBJECTIVE:** Evaluate the effectiveness and safety of the design of non-maneuvering vehicles for enabling the user to prepare them for use, connect and disconnect them, and use them as intended. The HFE subtest should give consideration to the evaluation of user performance and safety in conducting these functions with the item under conditions which are representative of those expected in actual use.

The conditions applicable to this class are:

1. User conditions - level of training and encumbrances, and conditions of the user which degrade soldier performance (such as noise levels impairing hearing, affecting his night vision).
2. Environmental conditions - weather, illumination, etc.
3. Operational conditions - time critical conditions (blackout, noise suppression) or

| PREPARE FOR USE   |   | CONNECT/DISCONNECT  |   |
|---|---|---|---|
| LOAD/UNLOAD MATERIALS   | SET UP FOR USE  | ENGAGE PRIME MOVER  | VERIFY OPERATION  |
| <p><b>PURPOSE:</b> Evaluate the design of the test item for adaptability to cargo loading facilities and practices. This function will deal with general types of cargo, as well as special equipment, such as would be subsequently employed in a shop van or other stationary work van.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Mate loading position with loading device.</p> <p>Open/close cargo doors.</p> <p>Lower/raise platform/ramp.</p> <p>Mount steps/etc. with load.</p> <p>Pass load up to platform/entryway.</p> <p>Transfer load to storage area.</p> <p>Secure load in/en item.</p> | <p><b>PURPOSE:</b> Evaluate the design of the item for ease of setting up as a temporary working station.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Transfer item to destination with prime mover.</p> <p>Install permanent equipment.</p> <p>Block/lock wheels.</p> <p>Level item.</p> <p>Attach temporary steps/stairs.</p> <p>Connect powerlines/cables/hoses.</p> <p>Deploy expendable units.</p> | <p><b>PURPOSE:</b> Evaluate the design of the item for ease of fastening to prime mover, including hitches, tow lines, hydraulic, air and electrical connections, alignment aids, retracting wheels, and other components used in the task of connecting to the prime mover.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Connect lines/hoses from mover to item.</p> <p>Prepare hitch/connection.</p> <p>Align/mate prime mover and item.</p> <p>Fasten/connect prime mover and item.</p> | <p><b>PURPOSE:</b> Evaluate the design of the item for ease of fastening to prime mover, including hitches, tow lines, hydraulic, air and electrical connections, alignment aids, retracting wheels, and other components used in the task of connecting to the prime mover.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Inspect hose/cable.</p> <p>Manually/visually check tightness.</p> <p>Tighten/adjust connections.</p> <p>Inspect external components.</p> <p>Read labels.</p> |

INDEX TO DETAILED-DESIGN CONSIDERATIONS

| Test Item Components<br>HUMAN FACTORS<br>CONSIDERATIONS | Steps<br>Ladders<br>Platform<br>(7) | Doors<br>Hatches<br>Passages<br>(4) | External<br>Components<br>(5) | Work-<br>space<br>(10) | Fastener<br>Connect-<br>ors<br>(13) | External<br>Components<br>(5) | Communi-<br>cations<br>(11) | Lines<br>Hoses<br>Cables<br>(12) | External<br>Components<br>(5) | Lines<br>Hoses<br>Cables<br>(12) | Fasteners<br>Connectors<br>(15) | Labels<br>Markings<br>(1) |  |
|---|-------------------------------------|-------------------------------------|-------------------------------|------------------------|-------------------------------------|-------------------------------|-----------------------------|----------------------------------|-------------------------------|----------------------------------|---------------------------------|---------------------------|--|
| A. LOCATION & ARRANGEMENT                               | A                                   | A                                   | A                             | A                      | A                                   | A                             | A                           | A                                | A                             | A                                | A                               | A                         |  |
| B. SIZE & SHAPE   | B                                   | B                                   | B                             | B                      | B                                   | B                             | B                           | B                                | B                             | B                                | B                               | B                         |  |
| C. DIRECTION & FORCE                                    | C                                   | C                                   | C                             | C                      | C                                   | C                             |                             | C                                | C                             | C                                | C                               |                           |  |
| D. CLEARANCE  | D                                   | D                                   | D                             | D                      | D                                   | D                             | D                           | D                                | D                             | D                                | D                               | D                         |  |
| E. VISIBILITY   | E                                   | E                                   | E                             | E                      | E                                   | E                             | E                           | E                                | E                             | E                                | E                               | E                         |  |
| F. USE CONDITIONS                                       | F                                   | F                                   | F                             | F                      | F                                   | F                             | F                           | F                                | F                             | F                                | F                               | F                         |  |
| G. SAFETY   | G                                   | G                                   | G                             | G                      | G                                   | G                             | G                           | G                                | G                             | G                                | G                               | G                         |  |
| H. OPERATING PROCEDURES                                 | H                                   | H                                   | H                             | H                      | H                                   | H                             | H                           | H                                | H                             | H                                | H                               | H                         |  |











[illegible]



TEST FUNCTION \_\_\_\_\_

TEST ITEM CLASS II \_\_\_\_\_

SUBCLASS A \_\_\_\_\_

OBJECTIVE: Evaluate the effectiveness and safety of the design of individual weapons to enable the user to prepare the weapon for use and to actually use it. The HFE subtest should consider evaluation of operator performance and safety for those functions under conditions representative of those expected in combat use of the weapon.

The

1. Use
2. Error
3. Operator can

| PREPARE FOR USE  |  |  |
|--|--|--|
| PRE-OPERATIONAL ACTIVITIES   | ASSEMBLE/EMPLACE   |  |
| <p>PURPOSE: Evaluate the design of the test item for the facility of the user to unpack, unstore, handle, field-strip, clean and to reassemble and adjust the weapon under a wide range of environmental and operational conditions.</p> <p>MAN/ITEM TASKS</p> <p>Store in/on vehicle.</p> <p>Unstore/unpack.</p> <p>Pick up/pick down.</p> <p>Carry in hand.</p> <p>Carry on body.</p> <p>Field-strip.</p> <p>Clean parts.</p> <p>Reassemble parts.</p> <p>Tighten connections.</p> <p>Adjust sights.</p> | <p>PURPOSE: Evaluate the test item for the ease of mating subassemblies, making the necessary connections, and placing in position for operation.</p> <p>MAN/ITEM TASKS</p> <p>Mate subassemblies.</p> <p>Mate connections.</p> <p>Engage.</p> <p>Position for firing.</p> | <p>PURPOSE: test the mating/mateable sights</p> <p>MAN/ITEM TASKS</p> <p>Select</p> <p>Mate</p> <p>Activate</p> <p>Ready</p> <p>Ready</p> <p>Ready</p> |

| Test Item Components<br>HUMAN ACTORS<br>CONSIDERATIONS | INDEX TO DETAIL          |              |                        |                  |                          |              |                    |
|--|--------------------------|--------------|------------------------|------------------|--------------------------|--------------|--------------------|
|  | Fastener Connectors (13) | Handles (14) | Operating Element (15) | Positioning (16) | Fastener Connectors (13) | Handles (14) | Label Marking (17) |
| A. LOCATION & ARRANGEMENT                              | A                        | A            | A                      | A                | A                        | A            | A                  |
| B. SIZE & SHAPE  | B                        | B            | B                      | B                | B                        | B            | B                  |
| C. DIRECTION & FORCE                                   | C                        | C            | C                      | C                | C                        | C            | C                  |
| D. CLEARANCE   | D                        | D            | D                      | D                | D                        | D            | D                  |
| E. VISIBILITY  | E                        | E            | E                      | E                | E                        | E            | E                  |
| F. USE CONDITIONS                                      | F                        | F            | F                      | F                | F                        | F            | F                  |
| G. SAFETY  | G                        | G            | G                      | G                | G                        | G            | G                  |
| H. OPERATING PROCEDURES                                | H                        | H            | H                      | H                | H                        | H            | H                  |







## SYSTEM COMPONENTS

### PRIMARY ACTIONS CURRENT ACTIONS

**A. LOCATION AND ACCESSIBILITY**  
The position of a component or its effect on the ability of the operator to reach, operate or manipulate it, including factors of operability (reach, control or use operation, location of components (knobs, levers, etc.) as well as its relationship to other components.

### B. SIZE & SHAPE

The maximum and/or minimum dimensions of components that are required for adequate use, including the effects of anthropometric and space of clothing (arctic, PFC) considerations, and the shape and location of handles, knobs and other controls to ensure both the ability to use and the safety of the component.

### C. DIRECTION OF FORCE

The movement and/or force required to operate or generally manipulate a component (handle, control, fastener, etc.), with emphasis on the direction of motion corresponding to the display, component, total item reaction or stick/lever position as well as the minimum strength required.

### D. CLARITY

The instructions given surrounding a component which allows the operator to perform required actions, the accuracy of which varies as a function of the amount of body involved (hand, fingers, arm, torso, etc.) and where designators, will also include considerations such as gloves, tools, helmets, protective clothing, etc.

### E. VISIBILITY

Those aspects of a component that contribute to the operator's ability to see it clearly, including location, size, shape, color, contrast, field of view, viewing distance, reflectance, and illumination.

### F. USE CONDITIONS

Those aspects of a component that pertain to its operational status before, during and after use, as well as the maintenance of an acceptable environment in the workspace areas.

### G. SAFETY

Those aspects of a component that could cause injury to the operator or other personnel, including preventive actions for bad weather or reduced visibility, accidental contact with electrical, temperature, chemical, radiation and pressurization hazards, and danger to sight and hearing, particularly under the conditions of alert or brittle stress.

### H. IDENTIFICATION PROCEDURES

Those operational and informational aspects affecting or improving man performance as found in equipment design handbooks as well as job aids, checklists, training texts, troubleshooting guides and repair manuals with specific attention to the safety aspects when using the components.

## 1. LABELS, MANUALS, MARKINGS

Provide technical guidance in the form of written material, schematics, diagrams, illustrations and instruction plates.  
Make operator aware of hazards.  
Give special guidance or instructions.

- Controls, displays, etc are clearly, appropriately labeled except where use is obvious.
- Labels placed on or near items they identify.
- Do not cover other information.
- Label is not behind control.
- Label location consistent.
- ID label: not obscured by components on flattest surface on main chassis; min coverage by grime not easily removed.

- Character height determined by distance read, luminance FIG 14.B.1.
- Group label characters larger than those of controls, displays which are larger than control, display position characters each by 25% min.
- Letter, numeral styles FIG 14.B.2-A.
- Height/width ratio = 5/8 "W" is 1 stroke width wider "M" & "W" are 5/8 "H" & "I" are 1 stroke width.
- Stroke width for black (white) characters on light (black) background 1/6 (1/7-1/8) of height.

- Spacing between characters (word) and stroke (character) width min.
- Line spacing: 1/2 character height.
- Counter numeral low ratio = 1/2 (except 1/2 separation = 1/2 to 1/2).
- Optical projections: all caps, stroke width 1/6 to 1/8 h; exceeds 15 minutes visual angle.
- Thumbnail numeral low ratio = 3/2 h = 1/2 stroke width intensity (externally) illuminated = 10x (5x).
- Abbreviations all caps, no periods.
- Extended copy uses lower case.
- Label characteristics determined by illumination level, color.
- Labels easily, accurately read at operational reading distance, vibration, light levels, environmental conditions.
- Labels are sharp with high or color contrast.
- With illumination above 1 ft-cd black letters, light background.
- Dark adaptations letters visible, do not interfere with night vision.
- Chart readings FIG 14.E.3.

- Label characteristics accuracy required: time available distance light level, color, criticality of function, consistency of design.
- Labels on production equipment are as durable as the equipment.
- Labels for prototype equipment easily affixed, altered, removed.
- Labels not covered by other units nor obscured by grime, dirt.
- Markings, tags are as permanent, washable as equipment.
- Roman numerals avoided.
- Vertical labels used only when labels are not critical for personnel safety, performance.
- Electrical receptacles marked with voltage, phase, frequency.
- Pipe, hose, tube lines clearly labeled as to contents, pressure, temperature, hazards.
- Warning placards illuminated.
- Placards adjacent to hazards.

- Abbreviations are standard (MIL-STD-121) new OK if obvious.
- Trade names, irrelevant info do not appear on labeling.
- Labels cancel min redundancy.
- Abstract symbol only if meaningful.
- Words familiar to user.
- Hand grasp areas identified.

- Minimum decoding required.
- Control color related to display.
- Diagrams used where possible.

## 6. CONTROLS

Components used to activate, deactivate and modify the equipment power source or to modulate the operating elements.  
Handles, grips, knobs, switches, triggers, levers, wheels, pedals and other man operated items as applicable.  
Controls are associated only with the item under test, not with equipment placed on it.

- Control relationship to its display is apparent, compatible.
- Functionally related controls are grouped together.
- Control groups, sequential operations have left-to-right and/or top-to-bottom order of use.
- Controls in functional groups are located in accordance with operational sequence and/or function.
- Controls oriented to operator.
- Can not accidentally be moved.
- Recurring groups similar throughout system.
- Rotary size, shape FIG 6.B.1-4.
- Linear size, shape FIG 6.B.7-12.
- Controls have non-slip surfaces.
- Gross (limiting) (adjustable) dimensions based on 95th% (5th%) (5-95th%) operator.
- Linear size, shape FIG 6.B.9-16.
- Minimize controls use only under space constraints; size and separation maximum.
- Rotary size, shape FIG 6.B.1-4.

- Adequate control response feedback.
- Control motion: CW, forward, up, right produces corresponding display motion on fixed scale (or reverse motion with a moving scale, fixed pointer) with increasing reading magnitude.
- Force, displacement (including miniature controls) FIG 6.B.1-16.
- Free from excessive backlash.

- Compatible with hardware used.
- Range of control action does not interfere with other controls.

- Shape coded controls visually, tactually identifiable.
- Pointers differentiated for each knob of group set.

- Precision of control manipulation is consistent with that of system.
- Selected, distributed to non-essential times are overburdened.
- Usable in time required despite inadvertent operation protection.
- Recommended manual controls FIG 6.F.1.
- ID rotaries: large (small) for small (large) range of display movement.

- Shape coding free of sharp edges.
- Critical controls are not susceptible to accidental movement.
- Controls that initiate hazardous operations require prior operation of a locking control.
- Emergency controls located near related warning display/hazardous hazard.

- Minimum decoding required.
- Control color related to display.
- Diagrams used where possible.

## 10. WORKSPACE

The area within which the user operates the equipment.  
Includes space for controls, displays, optics, electronic devices, weapons and windows as well as standing areas, consoles and seats.  
Provides storage for excess clothing, personal gear, weapons and tools.  
Protects operator from adverse environment, when applicable.

- Workspace allows ease of weapon handling, aiming, loading, firing, field stripping.

- Gross (limiting) dimensions based on 95th% (5th%) user: FIG 25.B.1-7.

- Stored arms readily accessible.

- Allowances made for heavy clothing, protective equipment.
- Workspace provides head, arm, body clearance at any weapon position.
- Sufficient clearance for use with gloves, arctic mitts, heavy clothing.
- User space not encroached upon by others.

- Illumination FIG 16.E.1.

- Acoustical environment does not degrade system effectiveness.
- Arctic climate: max not exposed to temp above 60°F; 35-45°F optimal.

- Exposure to gases, fumes, toxicities use THRESHOLD LIMIT VALUES.
- Impulse noise FIG 14.C.1.
- Noise duration limits FIG 14.C.3.
- Radiation hazards minimized.

- Conspicuous placards adjacent to equipment hazardous to user.
- Areas requiring special equipment, clothing are specifically identified.
- Emergency procedures detailed.
- Instructions kept simple.

## 13. FASTENERS, CONNECTORS

Securing devices used to assemble, package or hold an item in place.  
Catches, hooks, screws, bolts, nuts, latches - both quick release and fast operated.  
Includes fastener and connector alignment and locking devices such as lock pins, safety wires, pins, nuts, electrical plugs, and fittings.

- It is impossible to insert a wrong plug into a receptacle.
- Plugs, receptacles have aligning pins for insertion.
- Aligning pin extends beyond plug electrical pins.
- Plugs, receptacles arranged so aligning pins are oriented in the same relative position.
- Fastener, connector operating parts are easily accessible.
- Alignment aids, self alignment of parts for fastening.
- Identical screws, bolt heads provided throughout one removal tool.
- Fastener heads large enough to be grasped, handled.
- Non-interchangeable connectors for different use.
- Cotter key: snug fit, large head.
- Size, shape, color-coded pins avoid mismatches FIG 13.H.1.
- Connectors are physically different when lines carry different fluids.

- Fasteners, plugs require one turn min to tighten, loosen.
- Use 10 ft-lb torque use external, grippable below 10 ft-lb, use internal, external or combo grippable.
- Quick disconnect, snap action, release, twist up to one full turn for frequent, critical use.
- Tighten CW loosen CCW.

- Gross (limiting) dimensions based on 95th% (5th%) operator's hand, arm FIG 25.B.1-5.
- Adequate space available to grasp connectors firmly.
- Adequate space to use connector wrench.
- Obstructions to use are re-removable.
- Connectors are separated by 0.75" (1.25" if used with bare (gloved) fingers).
- Connectors easily reached by user in bulky, restrictive clothing.
- Connectors visible, accessible.
- Labels, codes visible in connected, disconnected state.
- Easy visual access is provided for starting threads, pins.
- ID colors are readily discriminable from each other under real operational lighting.

- Captive fasteners used where dropping them creates hazard: covers need frequent removal.
- Bolts have min number of turns.
- Only standard tools are used.
- Adapters for pin connectors can be hand tightened.
- Plugs, connectors are self locking.
- Fasteners used outside are operable under all environmental conditions.

- Removal of plug, connector does not expose hot leads.
- Plug of one voltage rating cannot be inserted into the receptacle of another voltage rating.
- All hot contacts are insulated.
- Internal-grip: only use when critical to mechanical function, personnel safety.
- Use captive type dust covers where necessary.
- Caps, inserts, covers, coats, shields provided where necessary.
- Receptacles marked as to voltage, phase, frequency.
- Connecting plugs, receptacles identified by color, size.
- Plugs, receptacles have stripes, arrows, etc to show aligning pin points.
- Marker of connection obvious.
- Non-standard operating direction is clearly marked.
- Plug, receptacle identification FIG 13.H.1.

- Hand grip has
- Removable, with handles, for grasping, lifting or moving
- Carried item of personnel.

## 14. HANDLES

The special is to grasp, hold, lift, moving, handles, knut etc.  
Involves rough face when used.  
Check also for

- Handles, pin relative to the
- Hinged, folding positions are 1
- Two handle handle/grasp or more
- Handles, local min distance 1
- Handles, rear wearing bulks

- Bar, T-bar, J FIG 14.B.1.
- Surface texture
- Hand shaped controls
- Hand shaped carried frequ

- Weight limits
- 14.C.1: if the
- 14.C.1: if the
- 14.C.1: if the

- Handles have
- Straps, buckle
- operation of 1

- Hand grips ha
- Removable, with handles, for grasping, lifting or moving
- Carried item of personnel.

- Handle/grasp
- Thermal/ryles
- Insulated hand
- Non-recessed
- personnel,
- damage equip
- 1 days round
- recessed.

- Hand grasp on



| 14 HANDLES   | 15 OPTICS   | 16 OPERATING ELEMENTS   | 17 PACKAGING  |
|--|---|---|---|
| <p>used to assemble, disassemble, move, hold, grip or lift an item for fitting, moving, stowing or removing. Handles, knobs, projections, straps, etc.</p> <p>Involves roughened or non-slip surface when used for handling. (Check also for the lack of handles.)</p> <p>Handles, grab areas are located relative to the CG.</p> <p>Thickest, fold-out handles have a stop pin from one hand operation.</p> <p>Two handles, min. or one handle/grip area for units 10 lbs. or more.</p> <p>Handles located so that lifting is at arm distance from body.</p> <p>Handles reachable by 5th% user wearing bulky, restrictive clothing.</p> <p>Bar, T-bar, J-bar, recessed handles FIG 14.B.1.</p> <p>Surface texture of hand-manipulated force controls maximizes operator's grip.</p> <p>Hand shaped handle used on item carried frequently or for long periods.</p> <p>Weight limits for one man lifts FIG 14.C.1; if shape is convenient, handles are provided, lift is not repeated, item is not carried.</p> <p>Handle, grip area force limits FIG 6.C.1.</p> <p>Handles have at least 20° clearance from obstruction.</p> <p>Straps, buckles do not interfere with operation of item.</p> <p>Handles color coded to distinguish from similar shaped items.</p> <p>Handles are visible from the grasping, lifting position.</p> <p>Hand grips have nonslip surface.</p> <p>Removable, carried units provided with handles, either suitable means for grasping, handling, carrying.</p> <p>Handles do not interfere with operating or maintaining item.</p> <p>Carried item will sit clear of legs of personnel.</p> <p>Handle/grip surfaces are not thermally/electrically conductive.</p> <p>Insulated handles used on hot items.</p> <p>Non-recessed handles do not injure personnel, entangle clothing, damage equipment.</p> <p>Edges rounded; attaching screws recessed.</p> <p>Hand grasp areas identified.</p> | <p>Components that use the human eye for sighting, aiming or viewing. Includes eyepieces, reticles, filters, sighting mechanisms, range finders, viewers.</p> <p>Excludes visual displays.</p> <p>Optical instruments are oriented to give operator a comfortable angle of view.</p> <p>Purging, changing fittings are accessible for maintenance.</p> <p>Components requiring frequent maintenance, special tools are readily accessible.</p> <p>Interpupillary distance between eyepieces adjustable 50-76 mm.</p> <p>Eyepiece prevent stray light from entering eyes.</p> <p>Built-in collimation for field adjust.</p> <p>Gross (limited) dimensions based on 95th% (5th%) user FIG 25.B.4.</p> <p>Field of view is compatible with use, optical-mechanical limits.</p> <p>Exit pupil = magnification x exit pupil diameter.</p> <p>Reticle lines thin enough not to block targets; thick enough to be easily seen.</p> <p>Eyepiece specifications FIG 15.B.1.</p> <p>Rifle, pistol sight (monocular, binocular) 4 (3) power max.</p> <p>2 eyepieces used during low light level viewing that exceeds 1 minute. Eyes don't have to adjust beyond normal functional ability.</p> <p>Magnification difference between the two eyes 2% max.</p> <p>Difference in amount of light between the two eyes 5% max.</p> <p>Eye relief is at least 15 mm.</p> <p>Eyepiece, headrest compatible with helmets, masks, etc.</p> <p>Slip scales useable by 5-95th% hands.</p> <p>Line reticles preferred over those with 1, 2 or 3 central spots.</p> <p>Small cross or circle preferred over dot for reticle.</p> <p>Ring preferred over a spot for reticle.</p> <p>Optic components accommodate arctic headwear, handwear.</p> <p>Reticles are illuminated for night, twilight operations.</p> <p>Illumination even blue color not used, dimming provided level remains fixed under vibration.</p> <p>Level vials, scales, pointers are readily visible, illuminated for low light condition use.</p> <p>Lighting minimally affects the dark adaptation of observer.</p> <p>Luminous transmission exceeds 50% parallel limited.</p> <p>Filters used for high light levels.</p> <p>Adjustment of eyes beyond normal ability is not required.</p> <p>Magnification is high enough for required application.</p> <p>Resolution: 3.0 c.p.t.</p> <p>Resolution: 60 sec of arc min.</p> <p>Observers are matched pairs.</p> <p>Instruments needing ready eye use have brow pads.</p> <p>Flash protection shutters do not disturb lay of weapon.</p> <p>Level vials, scales, pointers are protected from damage.</p> <p>Headrest, brow pad is used to absorb energy which would be injurious to the user's head.</p> <p>Eyepieces are made of soft rubber or equivalent material.</p> <p>Proper eye relief, exit pupil location is consistent with weapon recoil characteristics 25 mm min.</p> <p>No skin contact with metal parts.</p> <p>Components, parts are labeled.</p> <p>If periodic purging, charging is required on instruction plate indicating time interval, pressure is attached.</p> | <p>Components which control the operation of the item.</p> <p>Includes triggers, fuses, cranks, etc.</p> <p>Does not include controls as such, although there is some overlap.</p> <p>Controls used only for maintenance, adjustment are covered during normal operation but are accessible, visible when required.</p> <p>Subassemblies accessible from station of all times.</p> <p>Safety operable without removing hand from weapon.</p> <p>Any part of weapon that contacts user's skin has thermal insulation.</p> <p>Safety catches have a distinctive shape, location.</p> <p>Weapon controls have distinctive shapes, locations.</p> <p>Rifle, machine gun guidance dimensions FIG 16.B.1.</p> <p>Bore-sight knobs have resistance to lock, unlock 100b max.</p> <p>Triggers, safeties, aiming pins positive force, operable by 5th% user.</p> <p>Knobs preferred over screwdriver for frequent adjustment.</p> <p>Sight mount leveling vial supports strong enough to prevent bubble displacement.</p> <p>Recall, stress of field maneuvering does not disturb bubble extended, retracted setting.</p> <p>Parts can't be assembled backwards.</p> <p>Compatible with handwear used.</p> <p>Trigger guards, safety catches, etc accommodate gloved hand.</p> <p>Weapon ejects expended cases forward &amp; to the right.</p> <p>Retracted bipod cannot catch on vegetation.</p> <p>Operated elements must be visible when accessed, especially if hazards present.</p> <p>Elements that are moved are color or shape coded.</p> <p>Weapon settings are immediately obvious with user in normal firing position.</p> <p>Settings can be verified in normal firing position without moving body, weapon manipulating any sight component counting of visual, setting cues.</p> <p>Bore-sight knobs have positive lock.</p> <p>Weapon operable under difficult conditions of weather, clothing, temperature, terrain, climate, illumination.</p> <p>Weapon controls are sturdy enough so that normal field handling cannot damage them.</p> <p>Loading requires only inserting the magazine &amp; charging the weapon.</p> <p>Safety catches have positive action, standard operation.</p> <p>Mechanical operating parts guarded.</p> <p>CG, weight of equipment marked, where applicable.</p> <p>Control warning label located near hazard.</p> <p>Rate selectors, safeties, etc are clearly identified as to their positions.</p> <p>Magazine loading diagrammed if a particular pattern is required.</p> | <p>Components used for packaging, storage and transportation.</p> <p>Cases, packing cases, boxes, bags, and covers that are not part of the item but are used for transport.</p> <p>Carrying cases and storage boxes specifically designed for the item, or multiples of the item, and are part of the item configuration.</p> <p>Cases lift from units rather than units lift from cases.</p> <p>Inflammables stored away from engines, generators, exhaust pipes.</p> <p>For cross country ops items secured in storage boxes or restrained by straps, brackets.</p> <p>Stowage available for individual weapons, small-arms ammo, ration, helmets, etc.</p> <p>Stowed items accessible by 5-95th% personnel FIG 25.B.1-7.</p> <p>Small packages are sized for pockets, are relatively flat.</p> <p>Design Requirements (MIL-STD-1472)</p> <p>User-Computer Interface Data (MIL-STD-173C)</p> <p>Guidance Data (MIL-STD-1739, Etc.)</p> <p>Cases are enough larger than units they cover to prevent damage when case is moved, replaced.</p> <p>Tight fitting stowage avoided.</p> <p>Containers allow for full hand, finger clearance when using opening tool.</p> <p>Gloved hand clearance provided FIG 23.B.1.</p> <p>It is obvious when a cover is in place but not secured.</p> <p>Identification of package contents clearly visible.</p> <p>Cutlery, tools, steps are used to facilitate handling.</p> <p>Accessibility of stowed equipment reflects its function, use.</p> <p>Fully open, closed state obvious.</p> <p>Material remaining is easily determined.</p> <p>Sealed cans have integral opener device, strip, tab.</p> <p>Edges, corners on covers, cases are rounded, otherwise finished to prevent personnel injury.</p> <p>Orientation of a unit within its case is obvious or labeled.</p> <p>Labels, markings tell how to open, remove, position covers, cases.</p> <p>Labels warn of hazards, dangers within case.</p> <p>Stowage locations labeled.</p> |



TEST FUNCTION \_\_\_\_\_

TEST ITEM CLASS II \_\_\_\_\_

SUBCLASS B \_\_\_\_\_

OBJECTIVE: Evaluate the effectiveness and safety of the design of weapon systems to enable the crew to prepare the weapon for use and to actually use it. The HFE subtest should consider evaluation of crew performance and safety for these functions under conditions representative of those expected in actual combat use.

The cond

1. User con
2. Environ  
levels of
3. Operatio  
targets)

| PREPARE FOR USE   |  |   |
|---|--|---|
| PRE-OPERATIONAL ACTIVITIES  | ASSEMBLE/EMPLACE   | LOI   |
| <p>PURPOSE: Evaluate the design of the test item for the ability of the crew to unpack, unstow, handle, field-strip, clean and to reassemble and adjust the weapon.</p> <p>MAN/ITEM TASKS</p> <p>Unpack/unstow.</p> <p>Select modes of operation.</p> <p>Perform static checkout.</p> <p>Perform cleaning.</p> <p>Tighten connections.</p> <p>Verify readiness.</p> | <p>PURPOSE: Evaluate the test item for the ease of the mating subassemblies, making the necessary connections, placing in position for operation and the necessary communications between the personnel engaged in these tasks.</p> <p>MAN/ITEM TASKS</p> <p>Read instructions.</p> <p>Mate subassemblies.</p> <p>Emplace weapon.</p> <p>Identify ammunition.</p> <p>Stabilize weapon.</p> <p>Communicate.</p> | <p>PURPOSE: Ev test item for t mating ammun munition feed sights or other the weapon car verifying that completed.</p> <p>MAN/ITEM TA</p> <p>Select ammun</p> <p>Ready ammun</p> <p>Ready weapon t</p> <p>Load ammunite</p> <p>Verify loading.</p> <p>Ready sighting/</p> <p>Ready aiming a</p> <p>Ready visual ai</p> <p>Ready sensors.</p> <p>Ready weapon t</p> <p>Ready support t</p> |

| Test Item Components<br>HUMAN FACTORS<br>CONSIDERATIONS | INDEX TO DETAILED               |                 |                               |                             |                                     |                 | Labels<br>Manuals<br>Markings<br>(1) |
|---|---------------------------------|-----------------|-------------------------------|-----------------------------|-------------------------------------|-----------------|--------------------------------------|
|   | Fasteners<br>Connectors<br>(13) | Handles<br>(14) | Operating<br>Elements<br>(16) | Communi-<br>cations<br>(11) | Fastener<br>Conne-<br>ctors<br>(13) | Handles<br>(14) |                                      |
| A. LOCATION & ARRANGEMENT                               | A                               | A               | A                             | A                           | A                                   | A               | A                                    |
| B. SIZE & SHAPE   | B                               | B               | B                             | B                           | B                                   | B               | B                                    |
| C. DIRECTION & FORCE                                    | C                               | C               | C                             | C                           | C                                   | C               | C                                    |
| D. CLEARANCE  | D                               | D               | D                             | D                           | D                                   | D               | D                                    |
| E. VISIBILITY   | E                               | E               | E                             | E                           | E                                   | E               | E                                    |
| F. USE CONDITIONS                                       | F                               | F               | F                             | F                           | F                                   | F               | F                                    |
| G. SAFETY   | G                               | G               | G                             | G                           | G                                   | G               | G                                    |
| H. OPERATING PROCEDURES                                 | H                               | H               | H                             | H                           | H                                   | H               | H                                    |







## TEST ITEM COMPONENTS

## HUMAN FACTORS CONSIDERATIONS

### A LOCATION & ARRANGEMENT

The positioning of a component as it affects the ability of the operator to reach, operate or manipulate it, including location of openings (accesses), cover or door operation, location of components (knobs, levers, etc.) as well as its relationship to other components.

### B SIZE & SHAPE

The maximum and/or minimum dimensions of components that are required for adequate man use, including the effects of anthropometric and special clothing (aerobic, NBC) considerations, and the shape and contour of handles, knobs and other controls to enhance both the identification and use of the component.

### C DIRECTION & FORCE

The movement and/or force required to operate or generally manipulate a component (handle, control, fastener, etc.) with emphasis on the direction of motion corresponding to the display, component, total item reaction or standard practice as well as the minimum strength required.

### D CLEARANCE

The unobstructed space surrounding a component which allows the operator to perform required actions, the adequacy of which varies as a function of the amount of body involved (hand, fingers, arm, torso, etc.) and, where appropriate, will also include considerations such as gloves, boots, helmets, protective clothing, etc.

### E VISIBILITY

Those aspects of a component that contribute to the operator's ability to see it clearly, including location, size, shape, color, contrast, field of view, viewing distance, reflectance, and illumination.

### F USE CONDITIONS

Those aspects of a component that pertain to its operational status before, during and after use, as well as the maintenance of an acceptable environment in the workspace areas.

### G SAFETY

Those aspects of a component that could cause injury to the operator or other personnel, including preventative aspects for bad weather or reduced visibility, accidental contact with electrical, temperature, chemical, radiation and pressurization hazards, and danger to sight and hearing, particularly under the conditions of alert or battle stress.

### H OPERATING PROCEDURES

Those operational and informational aspects affecting or improving man performance as found in equipment design handbooks as well as job aids, checklists, training texts, troubleshooting guides and repair manuals with specific attention to the safety aspects when using the components.

## 1 LABELS, MANUALS, MARKINGS

Provide technical guidance in the form of written material, schematics, diagrams, illustrations and instruction plates. Make operator aware of hazards. Give special guidance or instructions.

Controls, displays, etc. are clearly, appropriately labeled except where use is obvious.  
Labels placed on or near items they identify.  
Do not cover other information.  
Label is not behind control.  
Label location consistent.  
ID labels not obscured by components on flat surfaces on main chassis; min coverage by grilles not easily removed.

Character height determined by distance read, luminance: FIG 6.B.1-1.  
Group label characters larger than those of controls, displays which are larger than control, display position characters each by 25% min.  
Letter, numeral styles: FIG 6.B.2-4.  
Height/width ratio = 5/3; "M" is 1 stroke width wider; "W" & "W" are 5/8; "I" & "I" are 1 stroke width.  
Stroke width for black (white) characters on light (black) background: 1/16 (1/7-1/8) of height.

Design Requirements (MIL-STD-1472)  
User-Computer Interface Data (MIL-STD-1472C)  
Guidance Data (MIL-HDBK-759, Etc.)

Spacing between characters (word) is one stroke (character) width min.  
Line spacing = 1 character height.  
Counter numeral row ratio = 1:1 (except 1:1 separation = 1/2 to 1/4).  
Optical projection: all caps, stroke width 1/6 to 1/8; exceeds 15 minutes visual angle.  
Thumbwheel numeral row ratio = 3/2; h = 1/2 stroke width internally (externally) illuminated = 10/11 (5/1).  
Abbreviations all caps, no periods.  
Extended copy use lower case.  
Label characteristics determined by illumination level, color.

Labels easily, accurately read at operational reading distance, vibration, light levels, environmental conditions.  
Labels are sharp with high or color contrast.  
With illumination above 1 ft-C: black letters, light background.  
Dark adaptation letters visible, do not interfere with night vision.  
Chart reading: FIG 6.E-3.

Label characteristics accuracy required: time available, distances, light level, color, criticality of function, consistency of design.  
Labels on production equipment are as durable as the equipment.  
Labels for prototype equipment easily affixed, altered, removed.  
Labels not covered by other units nor obscured by grilles, dirt.  
Markings, tags are as permanent, readable as equipment.  
Random numerals avoided.  
Vertical labels used only when labels are not critical for personnel safety, performance.  
Electrical receptacles marked with voltage, phase, frequency.  
Pipes, hoses, tube lines clearly labeled as to content, pressure, temperature, hazards.  
Warning placards illuminated.  
Placards adjacent to hazards.

Abbreviations are standard (MIL-STD-121) new OK if obvious.  
Trade names, irrelevant info do not appear on labeling.  
Labels convey min redundancy.  
Abstract symbol only if meaningful.  
Words familiar to user.  
Hand grasp areas identified.  
Axes of graphs labeled and graduated appropriately.  
Printed info directly usable min of decoding, interpolation.

## 6 CONTROLS

Components used to activate, deactivate and modify the equipment power source and to modulate the operating elements. Handles, grips, knobs, switches, triggers, levers, wheels, pedals and other man operated items as applicable. Controls are associated only with the item under test, not with equipment placed on it.

Control relationship to its display is apparent, compatible.  
Functionally related controls are grouped together.  
Control groups, sequential operations have left-to-right and/or top-to-bottom order of use.  
Controls in functional groups are located in accordance with operational sequence and/or function.  
Controls oriented to operator.  
Can not accidentally be moved.  
Recurring groups similar thru system.

Rotary size, shape: FIG 6.B.1-4.  
Linear size, shape: FIG 6.B.9-18.  
Controls have non-slip surfaces.  
Grips (limiting) (adjustable) dimensions based on 95th% (5th%) (5-95th%) operator.  
Miniature controls used only under space constraints size and separation maximum.  
Grid & stylus: displaced grids, display same size; mounted/oriented below display preserve directional correlation.

Adequate control response feedback.  
Conventional control movements: FIG 6.C.3.  
Controller/follower movement ratio, displacement proportional.  
Rotary valves open CCW.  
Forces, displacements (including miniature controls): FIG 6.B.1-21.  
High force controls: FIG 6.C.1-2.  
High force controls provide limb/body support: 3 sec. sustained operation max.

Control spacing min: FIG 6.D.1; blind operation, 5" min.  
Rotary separations: FIG 6.B.1-8.  
Linear separations: FIG 6.B.9-16.  
Compatible with hardware used.  
XY controllers: cordless operable with either hand.  
Foot switches separated 3" horizontally, 8" vertical minimum.  
Range of control action does not interfere with other controls.  
Larger diameter concentric control is used for fine adjustment.  
Shape code: controls visually, tactually identifiable.  
Color contrasts with background.  
Ambient light color determines usable control colors.  
Reference line has 50% min contrast with control color.

Painter parallax error between reference marks: 25% min.  
Thumbwheel internally lighted if ambient illumination below 1 ft-C.  
Thumbwheel readable 30° off-axis.  
Legend switch legend is legible.  
Precision of control manipulation is consistent with that of systems.  
Selected, distributed so none of user's limbs are overburdened.  
Coding uniform throughout system.  
Usable in time required despite inadvertent operation protection.  
Minimum use made of horizontal or 3-position toggle switches.  
System response times: FIG 6.F.2.

Lightpens have feedback of pen placement, actuation, and input reception.  
Shape coding free of sharp edges.  
Critical controls are not susceptible to accidental movement.  
"Dead man" control used when incapacity produces a critical condition.  
Controls that initiate hazardous operations require prior operation of a locking control.  
Main power ON-OFF switch cuts off power to equipment.  
Emergency controls located near related warning display/nearest head.  
Minimum decoding required.  
Control color related to display.  
Operating instructions provided except where use is obvious.  
Diagrams used where possible.  
Main power switch labeled.  
Value operation labeled, shown.  
Transition matrix rate easily retrieved.  
Internal software checks minimize user errors.  
Critical entries require user acknowledgment can be edited.

Control inputs result in positive response displayed to indicate performance.  
User chooses sequence of trans. action.  
Data entry requires explicit completion action: paced by user.

Standardization of keyboards within system.  
Keyboard arrangement, number of keys compatible with info to be entered.  
Heel rest provided for pedal angle over 20°.  
Pedals reached easily.  
Keyboards conform to MIL-STD-1280.

Isometric joystick: shaft length = 4.3" (7.1") grip diameter = 2".  
Isometric joystick: hand-grip for integral switching; otherwise finger-grip.  
7/16" switch per foot (preferred).  
Display interface controllers size, shape: FIG 6.B.19-21.  
Rotary size, shape: FIG 6.B.1-8.

Avoid the requirement of constant force on joystick.  
Isometric joystick: deflection minimal, perceptible.  
Isometric joystick: max. force for full output not to exceed 26.7 lbs.  
Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.  
Free from backlash.  
Display interface controllers forces, displacements: FIG 6.B.19-21.  
Display interface controllers clearance: FIG 6.B.19-21.

Follow-up refresh rate: grant enough to create continuous track in free-draw graphics.  
Pointers differentiated for each knob of analog set.  
Interface controllers: in rate control applications, indicators provided to facilitate returning followers to display.  
Variable function keys have a visual signal if standard function unavailable.

Small diameter ball tracker uses space constraints: precision not essential.  
XY controller uses position control of followers: data retrieval, entry; avoid free-draw graphics.  
Grid-stylus uses CRT data retrieval, entry, generation of free-draw graphics.  
Fixed function keys used for critical or frequent inputs.  
Cursor control is consistent with speed and accuracy requirements.  
Fast-operated switches located away from obstructions.  
Data manipulated without concern for internal storage.

Isometric joystick uses: visual feedback, minimal delay; tight coupling of input/output; return to center after entry requirement.  
Isometric joystick: delay between control movement and display response: 1 sec. max.  
Recommended manual controls: FIG 6.F.1.  
In bracketing, knobs swing thru 10-70° arc around target value.  
C/F ratios: large (small) for small (large) range of display movement.

Control inputs result in positive response displayed to indicate performance.  
User chooses sequence of trans. action.  
Data entry requires explicit completion action: paced by user.

## 8 DISPLAYS

Components that provide positive visual displays are associated with the item under test.

Display relationship: parent determines equipment displayed.  
Functionally related.  
Recurring groups, 1 panel to panel local.  
Displays, groups, h and/or top-to-bottom.  
Display positions consistent of equipment.  
Lighted control in unambiguously assigned.

Display viewing distance.  
Painter extends to score or extent and.  
Painters use elaborate parallax, back.  
CRT target visual minutes, 10 lines x 16" (10" mod).  
Counters, flags, p: FIG 6.B.1.

Switches: no stop between positions; resistance increases until snaps into position.  
Pedals return to original position after use.  
Stops at beginning and end of control active positions.  
Fast-operated control uses force needed greater than upper body movement, frequent operations; alternative shutdown control.  
Linear separations: FIG 6.B.9-18.

Lightpens have feedback of pen placement, actuation, and input reception.

Display face to line 45° min parallax.  
Frequently used data optimal visual zone.  
Illumination uniform.  
Indicator lights show sparingly, visible.  
Contrast, luminance.  
Flashing lights: 3-5.  
Color coding uses unused scales cover.  
Groups of information distinctive.

Display precision: consistent with that of system.  
Information display: precise, useful, degraded by vibration.  
Lights show function.  
Scales: linear, 10 numbers, 2 points oriented upright.  
Mechanical typist.  
Audio signal evaluation.  
Audio, verbal warn above background.  
Failure immediate.  
Signal absence does indicate light emergency, warning FIG 6.F.1; master.  
Audio warnings: tri-sophones and vocal.  
Audio signal act: flag nature of problem.  
Prohibited, persists used: FIG 6.B.1.  
Audio warning due until corrective.  
Minimum decoding.  
Coding techniques: false discrimination relationship, critical.  
Auditory displays: overburdened, input desirable; warning.  
Verbal warnings: on.  
Audio warnings: use.  
Labels: function located; graduated.  
Need for entry of information minimum.



to modulate the operating items as applicable.

## 8 DISPLAYS

Components that provide visual and auditory information to the operator concerning the status of operation. Provide positive indication of developing or current malfunctions. Displays are associated only with the item under test, not with equipment placed in or on it.

- Display relationship to control is apparent; determines control used, equipment displayed.
- Functionally related units grouped.
- Recurring groups, items have similar panel to panel location.
- Displays, groups have left-to-right and/or top-to-bottom order of use.
- Display positions correspond to positions of equipment monitored.
- Lighted control indicators are unambiguously associated with controls.
- Display viewing distances: 13-28".
- Pointer extends to but does not obscure or exceed index mark width.
- Pointers are close to dial to eliminate parallax, shadows.
- CRT target visual angle exceeds 2.0 minutes, 10 lines of resolution distance 16" (10" min).
- Counters, flags, printers, plotters: FIG 8.B.1.

• Displays are designed for the operational environment.

- Emergency, critical, important displays located in 30° cone about line of sight.
- Recurring tabular data is similarly located.
- Tabular data is displayed left-to-right, top-to-bottom.
- All data needed to support activity is grouped together.
- Simple menus used when all selections fit on 1 page.
- For hierarchical menus a direct function call capability is provided.

- Display pointers are aligned for common stable values.
- Tabular displays used to present row-column data.
- Information density held to minimum on critical task displays.
- Information displayed limited to that necessary to make decisions.
- Location and presence of control input data clearly indicated.

## 10 WORKSPACE

The area within which the user operates the equipment. Includes space for controls, displays, optics, electronic devices, weapons and windows as well as standing areas, consoles and seats. Provides storage for excess clothing, personal gear, weapons and tools. Protects operator from adverse environment, when applicable.

- Display placement above standing (seated) surfaces normal, 81-70" (64-66"); precisely, frequently read, 50-65" (44-35"), ± 21" from centerline.
- Controls on vertical surface above floor (seath normal, 34-70" (8-34"); precisely, frequently used, 34-53" (8-23"), ± 21" from user centerline.
- With vision over console top critical warning display 22" min above seat.
- Workspace allows ease of weapon handling, aiming, loading, firing, field stripping.
- Seats fit suitably clothed 5-95th% user without degrading performance. Arm rests 24" min.
- Back, seat height 17 min padding.
- Standard console: FIG 10.B.1-3.
- Cans (limiting) dimensions based on 5th, 50th, 95th % fully equipped user: 14", 25.1", 1.7". Area: 1.8, 2.5, 4.8.
- Adjustable dimensions fit 5-95th%.

- Vertical seat adjustments: 15-21" in 1" max increments.
- Seat backrest reclines 103-115°; supports torso so operator's eyes are within 3" of "eye-line".
- Cabinet kick space: 44" had min.
- Seat adjusts fore, aft: 4" min.
- Operator does not have to lift self to adjust seat.
- Padding does not restrict entry.
- Loader's seat removable, stowable.
- Easy access to, from station.
- Stowed arms readily accessible.
- Console front floor space 4' min.
- Knee room 34x20x18" had min.
- Workspace anthropometrics: FIG 10.B.1.1.
- Allowances made for heavy clothing, protective equipment.
- Seat adjustment overhead clearance from seat pan: 40" min.
- Loader can comfortably sit (stand) in closed (open) hatch mode.
- 1 man change barrel, service second armament in fighting compartment.
- User space not encroached upon.
- Right-left viewing angle for wrap-around console: 190° max.
- Illuminations: FIG 10.E.1.
- Instrument reflection avoided.
- Loader can see outside while operating in close hatch mode.
- Vision blocks field of view overlaps.

- Acoustical environment does not degrade system effectiveness.
- Noise levels: FIG 10.F.2-8.
- Whole body vibration limits: X, Y, Z, times FIG 10.F.3.
- Arctic climate hatch not exposed to temp above 60°F; 35-45°F optimal.
- Temperature allowances made for heavy clothing, hand physical labor, protective equipment.
- Protective padding used.

- Exposure to gases, fumes, toxicity: see THRESHOLD LIMIT VALUES.
- Impulse noise: FIG 10.G.1.
- Noise duration limits: FIG 10.G.3.
- Whole body vibration within twice that for proficiency: FIG 10.F.3.
- Hazard alerting device provided.
- Illumination adequate.
- Exposed edges (corners) rounded: 0.04" (0.5") min radius.
- Radiation hazards minimized.
- Motion sickness limits: FIG 10.G.4.
- Padding: non-abrasive, non-toxic.
- Adequate, suitable storage for manuals, worksheets, etc.
- Conspicuous placards adjacent to equipment hazardous to user.
- Areas requiring special equipment, clothing are specifically identified. Emergency procedures detailed. Instructions kept simple.
- Seat adjustment diagrammed.
- Manuals, markings include warnings on toxic, thermal hazards of heaters, exhaust gas.

## 11 COMMUNICATIONS

Devices and techniques for communicating information among crew men within the workspace, between the crew and externally located individuals, and between the crew and remotely located persons. Includes antennas, where applicable.

- Microphones, headphones, headsets permit hands-free operation.
- Accessible volume, gain controls are provided for each channel.
- Foot operated "Send-Receive" control when both hands busy.
- Radios, telephones are located for easy emergency access, time critical communications.
- Communication devices are located within easy reach of operator.

• Earphones, headsets easily adjusted, accommodates 5th-95th% users: FIG 25.B.6.

- Reach to communication controls is unobstructed.
- Workspace accommodates operators wearing earphones, headset.
- Radio antenna located to minimize radio-frequency hazards.

• Color coding used when multiple handsets are visible, available to operator.

- Microphone, headphone, single (multiple) speakers: 200-6100 Hz (100-4800 Hz) dynamic range 50 dB min.
- Microphones noise cancelling in 100 dB areas 10 dB rms min.
- Filtering, clipping is used to improve intelligibility.
- Binaural headsets used when ambient noise exceeds 85 dB(A).
- Volume, gains audible min: 110 dB max; squelched.
- Volume/power control has detent between min volume, off.
- Communication equipment worn by operator is comfortable; metal parts do not contact user's skin.
- Headsets worn in high ambient noise provide attenuation equal to ear protective devices.
- Warning signal intensity does not cause discomfort, "ringing" in the ears.
- Exposed metal parts grounded.
- System allows emergency messages top priority, does not interfere with their transmission, reception.
- Speaker hears own voice in his headset in phase with his speech.
- Voice communication intelligibility criteria: FIG 11.H.1.
- Audio signals coded as to maintenance, emergency, health hazard, etc. to minimize operator's visual display search.
- Instructions provided for use and fault detection for communications equipment.







## TEST FUNCTION

**TEST ITEM CLASS III**

**SUBCLASS A**

**OBJECTIVE:** Evaluate the effectiveness and safety of the design of man-operated material handlers to enable the operator to gain access and egress, prepare for operation, and to actually handle material. The HFE subtest should consider evaluation of operator performance and safety for these functions under conditions which are representative of those expected in actual use.

**The conditions applicable to this class**

1. User conditions - level of training experience and encumbrances;
2. Environmental conditions - noise and vibration, heat and cold, different levels of illumination;
3. Operational conditions - time critical conditions (duration of use, type of load).

| GAIN ACCESS/EGRESS   |   | PREPARE FOR OPERATIONS  |  |
|--|---|---|--|
| CLIMB UP/DOWN  | OPEN/CLOSE  | CHECKOUT  | TAKE/LEAVE SEAT  |
| <p><b>PURPOSE:</b> Evaluate the design of steps, ladders, platforms, handholds and labels for enabling a user to climb on to and off of the item.</p>  | <p><b>PURPOSE:</b> Evaluate the design of doors and other access covers for adequacy in enabling operators to open and close them from normal approach location inside or outside of workspace.</p> | <p><b>PURPOSE:</b> Evaluate the design of operating components, both external and internal, for allowing a user to perform a preoperational check.</p>  | <p><b>PURPOSE:</b> Evaluate the design of the seat for enabling a user to take and leave the seat in a position for egress, both nominal and emergency.</p>  |
| <p><b>MAN/ITEM TASKS</b></p> <p>Mount steps/ladders/ramps/etc.</p> <p>Use handholds.</p> <p>Use footholds.</p> <p>Carry load.</p> <p>Lift/lower load to/from platform/ledge.</p> <p>Read instructions/labels/warnings.</p> | <p><b>MAN/ITEM TASKS</b></p> <p>Grasp door handle.</p> <p>Unlock/lock door latch.</p> <p>Unlatch/latch door.</p> <p>Push/pull door open/shut.</p> <p>Use handholds.</p>                             | <p><b>MAN/ITEM TASKS</b></p> <p>Visually inspect external operating components.</p> <p>Verify adjustment, structural integrity, operational readiness.</p> <p>Input test signals to displays.</p> <p>Read/interpret displays.</p> <p>Determine control readiness.</p> <p>Set controls.</p> <p>Check load transport system.</p> <p>Check load lift system.</p> | <p><b>MAN/ITEM TASKS</b></p> <p>Step into/out of workspace.</p> <p>Take/leave seat.</p> <p>Move to/from operating position.</p> <p>Remove clothing if required.</p> <p>Stow clothing/encumbrances.</p> |

| INDEX TO DETAILED DESIGN CONSIDERATIONS |                             |                             |                        |                             |                             |                        |                            |
|---|-----------------------------|-----------------------------|------------------------|-----------------------------|-----------------------------|------------------------|----------------------------|
| Test Item Components                    | Labels Manuals Markings (1) | Steps Ladders Platforms (2) | Handholds Railings (3) | Labels Manuals Markings (1) | Steps Ladders Platforms (2) | Handholds Railings (3) | Doors Hatches Passages (4) |
| A. LOCATION & ARRANGEMENT               | A                           | A                           | A                      | A                           | A                           | A                      | A                          |
| B. SIZE & SHAPE                         | B                           | B                           | B                      | B                           | B                           | B                      | B                          |
| C. DIRECTION & FORCE                    |                             | C                           |                        |                             | C                           |                        | C                          |
| D. CLEARANCE                            | D                           | D                           | D                      | D                           | D                           | D                      | D                          |
| E. VISIBILITY                           | E                           | E                           | E                      | E                           | E                           | E                      | E                          |
| F. USE CONDITIONS                       | F                           | F                           | F                      | F                           | F                           | F                      | F                          |
| G. SAFETY                               | G                           | G                           | G                      | G                           | G                           | G                      | G                          |
| H. OPERATING PROCEDURES                 | H                           | H                           | H                      | H                           | H                           | H                      | H                          |



**MAN - OPERATED**

1. User conditions - level of training experience, body size of operators, and clothing and encumbrances;
2. Environmental conditions - noise and vibration environment in the use area, weather, heat and cold, different levels of illumination, and different types of terrain;
3. Operational conditions - time critical operations (emergency egress) and use conditions (duration of use, type of loads, distance of load transfer).

| PREPARE FOR OPERATIONS                                   |  | HANDLE MATERIEL   |  |
|--|--|---|--|
| ITEM   | TAKE/LEAVE POSITION  | ENGAGE LOAD   | LIFT/MOVE MATERIEL   |
| design of operation, external and internal, to perform a | <p><b>PURPOSE:</b> Evaluate the normal operating position for ease of entry and exit in both nominal and contingency conditions.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Step into/out of work area.</p> <p>Take/leave seat.</p> <p>Move to/from operating position.</p> <p>Remove clothing items/encumbrances.</p> <p>Stow clothing/encumbrances.</p> | <p><b>PURPOSE:</b> Evaluate the design of the test item for bringing the materiel handling element into contact with the materiel to be handled.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Activate item.</p> <p>Position materiel handling device.</p> <p>Orient materiel handling device.</p> <p>Identify load.</p> <p>Move materiel handling device to load.</p> <p>Control direction/speed of item.</p> <p>Acquire load.</p> <p>Verify acquisition.</p> | <p><b>PURPOSE:</b> Evaluate the design of the test item for performance of the operations of push, pull, lift, transport, and deposit materiel as required.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Read labels/instructions.</p> <p>Operate controls.</p> <p>Read/interpret displays.</p> <p>Lift load.</p> <p>Transport load.</p> <p>Identify deposit area.</p> <p>Deposit load.</p> <p>Monitor external objects/conditions.</p> <p>Communicate as required.</p> |

## DETAILED DESIGN CONSIDERATIONS

[illegible]







le work platforms  
and signs,  
identified,  
is it applicable,  
hazards,  
for slowing, em-

• 1 kg = 2.2 lbs, marked, identified.

- Color of latch handle different from that of door.
- Correct movement of latch handle diagrammed, labeled.
- Exit instructions are legible, brief, clearly worded.

- Capacity (barrelage) of different sizes, marked "A", "B", "C".
- Wrench instructions visible.
- Weight capacity indicated on stands, lifts, hoists, jacks.
- Dip sticks color coded.
- Fuel tank capacity labeled.
- Tire pressure labeled.
- Fuel, oil, coolant, hydraulic fluid paints labeled: type, grade.
- Electrical connections labeled.
- Special handling, assembly, operating procedures, precautions for cold weather accompany items.

**FC 6.6.1:**  
Shops cutting free of sharp edges.  
Critical controls are not susceptible to failure.  
"Dead man" control used when inactivity produces a critical condition.  
Controls that initiate hazardous operations require prior operation of a lockout control.  
Main power ON-OFF switch cuts off power to equipment.  
Emergency controls located near restricted warning display/area hand.  
Minimum guarding required.  
Control order related to display.  
Operating instructions provided except where use is obvious.  
Diagrams used where possible.  
Positions of shift handles shown.  
Control movements shown parallel to actual control movements.  
Lifting controls labeled as to function, direction.  
Main power switch labeled.  
Valve operation labeled, shown.

[illegible]







**SUBCLASS**      **IN**

**The conditions applicable to**

1. User conditions - training or boots, arctic mitts, bulky clothing
2. Environmental conditions - wind and vibration in the use area
3. Operational conditions - time conditions (duration of use, etc.)

## INDEX TO DETAILED DESIGN CON'

[illegible]



# OPERABILITY

## MATERIEL HANDLERS

### MAN - MONITORED

The conditions applicable to this class includes:

1. User conditions - training and experience, body size of operators and clothing (gloves, arctic mitts, bulky clothing, etc.);
2. Environmental conditions - weather, terrain, climate, illumination levels, noise and vibration in the use area;
3. Operational conditions - time critical operations (emergency egress) and use conditions (duration of use, frequency of activities, 1 or 2 man performance).

| PREPARE FOR USE   |   | START/MONITOR/STOP  |  |
|---|---|---|--|
|   | ALIGN/ADJUST  | INITIATE/TERMINATE  | MONITOR  |
| <p>st item for<br/>ational sta-<br/>nts, includ-<br/>uid levels,<br/>alignment,<br/>y readings,</p> <p>v/measure-</p> | <p>PURPOSE: Evaluate the design of the test item for performance of on-line adjustment, alignment, or calibration both prior to and during operations, as a direct result of the check-out or monitoring tasks.</p> <p>MAN/ITEM TASKS</p> <p>Make gross calibrations/adjustments manually.</p> <p>Use tools/controls for fine adjustments.</p> <p>Tighten connections.</p> <p>Realign components as required.</p> <p>Change control settings.</p> | <p>PURPOSE: Evaluate the design of the test item for starting and stopping the power subsystem, the movement of materiel, as well as for the loading and unloading of materiel.</p> <p>MAN/ITEM TASKS</p> <p>Take operating position.</p> <p>Determine when to start.</p> <p>Start/stop power.</p> <p>Operate power setting control.</p> <p>Begin loading/transferring operations.</p> <p>Operate controls for continued operation.</p> | <p>PURPOSE: Evaluate the design of the test item for determining the status of materiel in transit or in storage, and for verifying the operating condition of the item itself.</p> <p>MAN/ITEM TASKS</p> <p>Observe operation.</p> <p>Observe status.</p> <p>Observe performance.</p> <p>Determine rate of flow.</p> <p>Obtain samples.</p> <p>Identify problems.</p> <p>Communicate.</p> |

### MAILED DESIGN CONSIDERATIONS

| Displays<br>(8) | Controls<br>(6) | Displays<br>(8) | Access<br>Covers<br>Caps<br>(12) | Controls<br>(4) | Displays<br>(8) | Workspace<br>(10) | Controls<br>(6) | Displays<br>(8) | Communi-<br>cations<br>(11) | Access<br>Covers<br>Caps<br>(12) |
|-----------------|-----------------|-----------------|----------------------------------|-----------------|-----------------|-------------------|-----------------|-----------------|-----------------------------|----------------------------------|
| A               | A               | A               | A                                | A               | A               | A                 | A               | A               | A                           | A                                |
| B               | B               | B               | B                                | B               | B               | B                 | B               | B               | B                           | B                                |
|                 | C               |                 | C                                | C               |                 | C                 | C               |                 |                             | C                                |
|                 | D               |                 | D                                | D               |                 | D                 | D               |                 | D                           | D                                |
| E               | E               | E               | E                                | E               | E               | F                 | E               | E               |                             |                                  |
| F               | F               | F               | F                                | F               | F               | F                 | F               | F               | F                           | F                                |
| G               | G               | G               | G                                | G               | G               | G                 | G               | G               | G                           | G                                |
| H               | H               | H               | H                                | H               | H               | H                 | H               | H               | H                           | H                                |



## TEST ITEM COMPONENTS

### 18 HUMAN FACTORS CONSIDERATIONS

**A POSITIONING OF COMPONENTS**  
The positioning of a component as it affects the ability of the operator to reach, operate or manipulate it, including location of controls, functions, covers or clear openings, location of components (handles, levers, etc.) as well as its relationship to other components.

### B SIZE / QUANT

The maximum and/or minimum dimensions of components that are required for adequate man use, including the effects of anthropometric data, age, sex, clothing (jackets, NER), considerations, and the shape and contour of handles, levers and other controls to reduce both the identification and use of the component.

### C DIRECTIONAL FORCE

The maximum and/or force required to operate or manipulate a component (handle, control, fastener, etc.), with emphasis on the direction of motion corresponding to the display, component, label, etc. as well as the minimum strength required.

### D CLEARANCE

The unobstructed space surrounding a component which allows the operator to perform required actions, the clearance of which varies as a function of the amount of body involved (head, torso, arms, legs, etc.), and where appropriate, will also include considerations such as gloves, boots, helmets, protective clothing, etc.

### E VISIBILITY

Those aspects of a component that contribute to the operator's ability to see it clearly, including location, size, shape, color, contrast, field of view, viewing distance, reflectance, and illumination.

### F USE CONDITIONS

Those aspects of a component that pertain to its operational status before, during and after use, as well as the maintenance of an acceptable environment in the workspace areas.

### G SAFETY

Those aspects of a component that could cause injury to the operator or other personnel, including preventive aspects for bad weather or reduced visibility, accidental contact with electrical, temperature, chemical, radiation and pressurization hazards, and danger to sight and hearing, particularly under the conditions of alert or battle stress.

### H OPERATING PROCEDURES

Those aspects of a component that affect the operator's performance in the use of equipment, including the use of equipment, checklists, training tests, troubleshooting guides and repair manuals with specific attention to the safety aspects of the component.

## 1 LABELS, MANUALS, MARKINGS

Provide technical guidance in the form of written material, schematics, diagrams, illustrations and instruction plates.  
Make operator aware of hazards.  
Give special guidance or instructions.

- Controls, displays, etc. are clearly, appropriately labeled except where use is obvious.
- Labels placed on or near items they identify.
- Do not cover other information.
- Label is not behind control.
- Display location consistent.
- ID labels not obscured by component on flat surface on main chassis; min coverage by grommet not easily removed.
- Character height determined by distance read, luminance FIG 1.B.1.
- Group label characters larger than those of controls, displays which are larger than control, display position characters each by 25% min.
- Letter, numeral styles FIG 1.B.2-A.
- Height/width ratio = 5/3; "M" is 1 stroke width; "W" & "W" are 1 stroke width.
- Stroke width for black (white) characters on light (black) backgrounds 1/6 (1/7-1/8) of height.

- Spacing between characters (word) one stroke (character) width min.
- Line spacing: 5 character height.
- Counter numeral line ratio = 1/1 (except 1) separation = 5/8 to 1/2 in.
- Optical projections: all caps, stroke width 1/6 to 1/8 h; exceeds 15 minutes visual angle.
- Thumbwheel numeral line ratio = 3/2; h = 5/8 stroke width internally (externally) illuminated = 10/1 (5/1).
- Abbreviations all caps, no periods.
- Extended copy uses lower case.
- Label characteristics determined by illumination level, color.
- Labels easily, accurately read at operational reading distance, vibration, light levels, environments.
- Labels are sharp with high or color contrast.
- With illumination above 1 ft-C black letters, light background.
- Dark adaptations letters visible, do not interfere with night vision.
- Chart readings FIG 1.B.2-J.

- Label characteristics accuracy required: time available; distance; light level; color; contrast; or function; consistency of design.
- Labels on production equipment are as durable as the equipment.
- Labels for prototype equipment easily affixed, altered, removed.
- Labels not covered by other units nor obscured by grease, dirt.
- Markings, tags are as permanent, washable as equipment.
- Human numerals as aided.
- Vertical labels used only when labels are not critical for personnel safety, performance.
- Warning placards (illuminated).
- Warning notices clear, direct; characters 25% larger than any following instructions.
- Placards adjacent to hazards.

- Abbreviations are standard (MIL-STD-127) new OK if obvious.
- Trade names, relevant info do not appear on labeling.
- Labels concise; min redundancy.
- Abstract symbol only if meaningful.
- Words familiar to user.
- Hand group areas identified.
- Printed info directly readable min of decoding, interpretation.

## 6 CONTROLS

Components used to activate, deactivate or modify the equipment power, source and to modulate the operating elements.  
Handles, grips, levers, switches, triggers, levers, wheels, pedals and other man operated items as applicable.  
Controls are associated only with the item under test, not with equipment placed on it.

- Control relationship to its display is apparent, compatible.
- Functionally related controls are grouped together.
- Control groups, sequential operations have left-to-right and/or top-to-bottom order of use.
- Controls in functional groups are located in accordance with operational sequence and/or function.
- Controls oriented to operator.
- Can not accidentally be moved.
- Recurring groups similar thru system.
- Controls used for same function on different equipment are same size.
- Rotary size, shape: 1.8, 6.5, 1-8.
- Linear size shapes FIG 6.B.7-13.
- Controls have non-slip surfaces.
- Gras (lifting) (displacement) dimensions based on 95th (5th) (5-75th) operator.
- Keyboard push-buttons uniform.
- Linear size, shape: FIG 6.B.9-16.

- Adequate control response feedback.
- Conventional control movements: FIG 6.C.3.
- Stops of beginning and end of control active positions.

- Rotary size, shape: 1.8, 6.5, 1-8.
- Forces, displacements (including miniature controls) FIG 6.B.1-21.
- Free from backlash.
- Display interface controllers forces, displacements: FIG 6.B.19-21.
- Control spacing min: FIG 6.D.1; blind operation, 3" min.
- Rotary separations: FIG 6.B.1-8.
- Linear separations: FIG 6.B.9-16.
- Compatible with handwear used.
- Foot switches separated 2" horizontally, 8" vertical minimum.
- Range of control action does not interfere with other controls.
- Larger diameter concentric control is used for the fine adjustment.

- Shape coded controls visually, tactually identifiable.
- Color contrasts with background.
- Ambient light color determines useable control colors.
- Reference line has 50% min contrast with control color.
- Pointer parallel error between reference marks 25% min.
- Thumbwheel internally lighted if ambient illumination below 1 ft-C.
- Thumbwheel readable 30° off-axis.
- Legend switch legend is legible.
- Precision of control manipulation is consistent with that of system.
- Selected, distributed as name of user's limbs are over burdened.
- Coding uniform throughout system.
- Unable in time required despite inadvertent operation protection.
- Movement oriented to operator if several stations are used.
- Control motion minimum; not cycled thru ON/OFF unnecessarily.
- Recommended manual controls: FIG 6.F.1.
- Shape coding free of sharp edges.
- Critical controls are not susceptible to accidental movement.
- Controls that initiate hazardous operations require prior operation of a locking control.
- Main power ON/OFF switch cuts all power to equipment.
- Emergency controls located near related warning display/monitor hand.
- Foot-operated switches located away from distractions.
- Minimum decoding required.
- Control color related to display.
- Operating instructions provided except where use is obvious.
- Diagrams used where possible.
- Main power switch labeled.
- Valve operation labeled, shown.
- Emergency (noncritical) functional groups outlined with 3/16" red (1/16" black) bar.
- Controls labeled as to function.

## 8 DISPLAYS

Components that provide visual and auditory information to the operator concerning the status of operation. Provide positive indication of developing or current malfunctions. Displays are associated only with the item under test, not with equipment placed in or on it.

- Display relationship to control is apparent; determine control used, equipment displayed.
- Recurring groups, items have similar panel to panel location.
- Displays, groups have left-to-right and/or top-to-bottom order of use.
- Display positions correspond to positions of equipment monitored.
- Lighted control indicators are unambiguously associated with controls.
- Display pointers are aligned for common stable values.
- Display viewing distance: 13-20".
- Pointer extends to but does not obscure or exceed index mark width.
- Pointers are close to dial to eliminate parallax, shadows.
- Counters, flags, printers, plotters: FIG 8.B.1.
- CRT target visual angle exceeds 2.0 minutes, 10 lines of resolution distance 16" (10" min).

- Display face to line of sight exceeds 45° min parallax, reflection.
- Frequently used displays grouped in optimal visual zone: FIG 8.E.1.
- Illumination uniform: FIG 8.E.3.
- Indicator lights show response, used sparingly, visible.
- Contrast, luminance exceeds 50%.
- Flashing lights: 3.5 flashes/sec.
- Indicators used at night illuminated, dimmable 0.02-1.0 ft-L.
- Supplementary viewing system provided for remote handling.
- Display precision, response is consistent with that of system.
- Information displayed: Clear, specific, precise, useable; not redundant, degraded by vibrations timely.
- Lights show functions: FIG 8.F.1.
- Scales: linear, start at 0, use whole numbers, 2 pointers max, numerals oriented upright.
- Mechanical types: FIG 8.F.2.
- Audio signal evaluations: FIG 8.F.3.
- Audio, verbal warnings: 20 dB min above background.
- Failure immediately apparent.
- Signal absence does not mean "off".
- Indicator light color coding for emergency, warning, summation, etc: FIG 8.F.1; master lights set apart.
- Audio warnings transmitted to both earphones and work area.
- Audio signal action segment specific nature of problem.
- Prohibited, persistent signals are not used: FIG 8.G.1.
- Audio warning direction min of 5 sec; until corrective action taken.
- Minimum decoding required.
- Trademarks, irrelevant information, etc do not appear on panel face.
- Coding techniques uniform facilitate discrimination, identification, relationship, criticality.
- Auditory displays used where vision overburdened, degraded; redundancy desirable; warning, cue needed.
- Verbal warnings intelligible, apt.
- Audio warnings use standard signals.
- Labels functionally basic; well located; graduated in size.

- Illumination balanced full on to off.
- Transilluminated displays: FIG 8.F.3.
- Operator and maintainer information not combined unless compatible for both uses.

## 10 WORK

The area where the operator sits, stands, or operates. Includes the operator's seat, floor, and window console and provides personal and protective environment.

- Display 1 (seated) 65° prec 65° (16-31)
- Controls (seated) 18-27°, 2
- Work surface 18-27°, 2
- Dash top 18-27°, 2
- Control panel 18-27°, 2
- Standard 18-27°, 2
- Controls (for 18-27°, 2)
- Adjustable

- Vertical 9
- Seat back 18-27°, 2
- If arms at 18-27°, 2
- Operator to adjust

- Cabinet 18-27°, 2
- Console 18-27°, 2
- Work area 18-27°, 2
- Allowance protective 18-27°, 2
- Sufficient 18-27°, 2
- User 18-27°, 2

- Right-left 18-27°, 2
- Around 18-27°, 2
- Illumination 18-27°, 2
- Instrument 18-27°, 2
- Direct 18-27°, 2
- Distortion 18-27°, 2
- Reflection 18-27°, 2

- Seating 18-27°, 2
- Detail 18-27°, 2
- B.S.P. 18-27°, 2
- Ventilation 18-27°, 2
- Facility 18-27°, 2
- Effective 18-27°, 2
- Acoustic 18-27°, 2
- Grade 18-27°, 2
- Noise 18-27°, 2
- Room 18-27°, 2
- Whole 18-27°, 2
- Time 18-27°, 2
- Exposure 18-27°, 2
- See 18-27°, 2
- Impulse 18-27°, 2
- Noise 18-27°, 2
- Hazard 18-27°, 2
- Illumination 18-27°, 2
- Equipment 18-27°, 2
- Exposure 18-27°, 2
- 0.04" 18-27°, 2
- Guards 18-27°, 2
- Motion 18-27°, 2
- Fire 18-27°, 2
- Adequate 18-27°, 2
- Units 18-27°, 2
- Standards 18-27°, 2
- Part 18-27°, 2
- Elevators 18-27°, 2
- Lead 18-27°, 2
- Conducive 18-27°, 2
- Areas 18-27°, 2
- Emergency 18-27°, 2
- Instructive 18-27°, 2



## INITIALS

are used to activate, de-activate, and modify the equipment status and to indicate the status of the equipment.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

It is the responsibility of the operator to ensure that the equipment is in a safe state before use.

## 8 DISPLAYS

Components that provide visual and auditory information to the operator concerning the status of operation.

Provide positive indication of developing or current malfunctions.

Displays are associated only with the item under test, not with equipment placed in or on it.

Display relationship to control is apparent; determines control used, equipment displayed.

Recurring groups, items have similar control to panel location.

Displays, groups have left-to-right and/or top-to-bottom order of use.

Display positions correspond to positions of equipment monitored.

Lighted control indicators are unambiguously associated with controls.

Display pointers are aligned for common scale values.

Display viewing distance 13-20".

Pointer extends to but does not obscure or exceed index mark width.

Pointers are close to dial to eliminate parallax, shadows.

Counters, flags, printers, plotters FIG 8.B.1.

GMT target visual angle exceeds 2.0 minutes, 10 lines of resolution distance 16" (10" min).

Display face to line of sight exceeds 45° min parallax, reflection.

Frequently used displays grouped in optimal visual zones FIG 8.E.1.

Illumination uniform FIG 8.E.3.

Indicator lights show response, used sparingly, visible.

Contrast, luminance exceeds 50%.

Flashing lights 3-5 flashes/sec.

Indicators used at night illuminated, dimmable 0.02-1.0 ft-L.

Supplementary viewing system provided for remote handling.

Display precision, response is consistent with that of system.

Information displayed: Clear, specific, precise, unambiguous; not redundant, degraded by vibrations timely.

Lights show functions FIG 8.F.1.

Scales: linear, start at 0, use whole numbers, 2 pointers max, numerals oriented upright.

Mechanical types: FIG 8.F.2.

Audio signal evaluation: FIG 8.F.3.

Audio, verbal warnings 20 dB min above background.

Failure immediately apparent.

Signal absence does not mean "go".

Indicator light color coding for emergency, warning, summation, etc FIG 8.F.1; master lights set apart.

Audio warnings transmitted to both earphones and work area.

Audio signal action segment specifies nature of problem.

Prohibited, persistent signals are not used FIG 8.G.1.

Audio warning durations min of 5 sec; until corrective action taken.

Minimum decoding required.

Transients, irrelevant information, etc do not appear on panel face.

Coding techniques uniform; facilitate discrimination, identification, relationship, criticality.

Auxiliary displays used when vision overburdened, degraded; redundancy desirable; warning, cue needed.

Verbal warnings intelligible, apt.

Audio warnings use standard signals.

Labels: functional; basic well located; graduated in size.

Illumination balanced full on to off.

Transilluminated displays FIG 8.F.3.

Operator and maintainer information not combined unless compatible for both uses.

## 10 WORKSPACE

The area within which the user operates the equipment.

Includes space for controls, displays, optics, electronic devices, weapons and windows as well as standing areas, canopies and seats.

Provides storage for excess clothing, personal gear, weapons and tools.

Protects operator from adverse environment, when applicable.

Display placement above standing (seated) surfaces normal, 41-70" (6-40") precisely, frequently read, 50-65" (16-35") ± 2" from centerline.

Controls on vertical surface above floor (to each normal, 36-70" (8-34") precisely, frequently used, 36-53" (8-27") ± 2" from user centerline.

Work surface height standing, 36 ± 1" seated, 27-31".

Desk tops, writing tables are 29-31" above floor.

Display reading location identified.

Standard canopies FIG 10.B.1-3.

Grass (limiting) dimensions based on 95th % (5th % fully equipped users) FIG 10.B.1-2. Area FIG 10.B.1-3.

Adjustable dimensions fit 5-95th %.

Vertical seat adjustments 15-27" in 1" increments.

Seat backrest reclines 83-115°; supports torso so operator's eyes are within 3" of "eye-line".

If arms adjust 76-111° above seat.

Seat adjusts fore, aft 4" min.

Operator does not have to lift self to adjust seat.

Cabinet kick space 4x4" min.

Canopy front floor space 4" min.

Knee room 25x20x18" min.

Work area - anthropometric 111, 101, 112.

Allowances made for heavy clothing, protective equipment.

Sufficient clearance for use with gloves, arctic mitts, heavy clothing.

User space not encroached upon by others.

Right-left viewing angle for wrap-around canopies 190° max.

Illuminations FIG 10.E.1.

Forward field of view 80° min.

Instrument reflection avoided.

Direct view of work if possible.

Distortion avoided in windows.

Reflections FIG 10.E.3.

Seating compatible with controls.

Heating, A/C for mobile (permanent) detail work areas 50° F (65° F) to 85° F, does not discharge on crew.

Ventilation 30 cu ft/min man min velocity 100 ft/min max.

Effective temperature FIG 10.F.1.

Acoustical environment does not degrade system effectiveness.

Noise levels FIG 10.F.2-4.

Room sound absorption 0.20 min.

Whole body vibration limits X, Y, Z, time FIG 10.F.3.

Exposure to gases, fumes, toxicity see THRESHOLD LIMIT VALUES.

Impulse noise FIG 10.G.1.

Noise duration limits FIG 10.G.3.

Hazard alerting device provided.

Illumination adequate.

Equipment guarded if temp exceeds 140°F (120°F if handled).

Exposed edges (corners) rounded 0.04" (0.5") min radius.

Guards provided on moving parts.

Motion sickness limits: FIG 10.G.4.

Fire extinguisher accessible.

Adequate, suitable storage for manuals, worksheets, etc.

Standards have work surfaces to support manuals, etc.

Elevators, hydraulic lifts have max load sign visible.

Conspicuous placards adjacent to equipment hazardous to user.

Areas requiring special equipment, clothing are specifically identified.

Emergency procedures detailed.

Instructions kept simple.

## 11 COMMUNICATIONS

Devices and techniques for communicating information among crew members within the workspace, between the crew and externally located individuals, and between the crew and remotely located persons.

Includes antennas, where applicable.

Microphones, headphones, headsets permit hands-free operation.

Accessible volume, gain controls are provided for each channel.

Fast operated "Send-Receive" control when both hands busy.

Headsets, microphones are located for easy emergency action, where critical communications.

Earphones, headsets easily adjusted, accommodates 5th-95th % users FIG 11.B.4.

Reach to communication controls is unobstructed.

Workspace accommodates operators wearing earphones, headset.

Radio antenna located to minimize radio-frequency hazards.

Design Requirements (MIL-STD-1472)

User-Computer Interface Data (MIL-STD-1472C)

Guidance Data (MIL-STD-1472D, etc.)

Microphones, headphones, single (multiple) speakers 200-6100 Hz (100-4800 Hz) dynamic range 50 dB min.

Microphones noise cancelling in 100 dB range 10 dB min.

Filtering, clipping is used to improve intelligibility.

Binaural headsets used when ambient noise exceeds 85 dB(A).

Volume, gain, audible min 110 dB max; squelched.

Volume/power control has detent between min volume, off.

Communication equipment worn by operator is comfortable; metal parts do not contact user's skin.

Headsets worn in high ambient noise provide attenuation equal to ear protective devices.

Exposed metal parts grounded.

System allows emergency messages top priority, does not interfere with their transmission, reception.

Antennas, waveguides grounded.

Speaker hears own voice in his headset in phase with his speech.

Voice communication intelligibility criteria FIG 11.H.1.

Audio signals coded as to maintenance, emergency, health hazard, etc to minimize operator's visual display search.

Instructions provided for use and fault detection for communications equipment.

## 12 LINES, HOSES, CABLES

All cables, wires, lines, hoses, pipes, etc., that pass from or to a test item.

Plugs, sockets, quick-disconnect fittings for the above.

Includes components for transport as well as for stationary use.

Conductors are bound into cable held by lacing tape.

Long conductors, cables internal equipment are clamped to chassis.

Test cables terminating on control panel do not interfere with control displays.

Reels, reel carts provided to handle large, heavy, long lines, cables.

Covered space for cable storage.

Cable clamps spaced every 12".

Line, cable attachment parts reach cable by user in bulky clothing.

Cables are long enough to allow functioning unit to be checked or conveniently or extension cables are added.

Electrical plugs size, shape coded.

Line fittings standardized so line that differ in content are not inter-changeable.

Cables are size, shape coded to similar components.

Hand operation or common test used to tighten, loosen.

Tighten CW; loosen CCW.

Adequate space provided to handle cables, lines, hoses.

Clearance between cables & controls 3" min.

Cable, line, hose connectors operable by user wearing arctic mittens.

ID tapes visible at line ends, intervals near valves, vents, etc.

Bands, tags, paint are adjacent to valves, regulators, clean lines, flow checks, clean out, branch lines, or intervals & where line goes thru walls, floors.

Line, hose, cable color contrast with background.

Low overhead pipes highly visible.

Manner of connection, disconnect is obvious.

Number of inputs, outputs are minimized by grouping functions.

Cables are reachable, visible.

Irregular, fragile, awkward extensions removable for handling.

Cables are not pinched by doors, lids, walked on, used as handholds, bent, twisted repeatedly.

Cables routed thru holes are protected by grommets, etc.

Protective caps, covers, inserts are available as necessary.

Pipes, hoses guarded if temp over 140°F (120°F if handled).

High pressure lines have retaining chain attached to line and source.

Automatic shutoffs on fuel service equipment to prevent overflow, spills, etc.

Electric wiring routed away from lines carrying O<sub>2</sub> flammable fluids.

Multiple conductors color coded.

Cables labeled as to which equipment, connector they belong.

Lines labeled as to function, sub-function, hazard, flow: FIG 12.H.1.

ID tapes encircle the line.

ID tags, bands on cold, hot lines stainless steel 4" not near intakes.

ID point used on 4" min lines.

Line color (symbol) (hazard) code: FIG 12.H.2 (12.H.3) (12.H.4).

Dangerous voltage placarded.

Hydraulic, electric FIG 12.H.5-6.



| 10  | 11 COMMUNICATIONS  | 12 LINES, HOSES, CABLES   | 13 FASTENERS, CONNECTORS  | 17 PACKAGING   | 18 TEST ELEMENTS, TOOLS   |
|---|--|---|---|--|---|
| <p>which the user operates controls, displays, devices, equipment, as standing areas, for excess clothing, gear and tools, to from where applicable.</p> <p>and above (standing): normal, 81-70P (6 frequently read, 50 1" from centerline; local surface above, 36-70P (2-3A); only used, 36-57" in user centerline; light: standing, 26-31" as tables are 29-31"</p> <p>ation identified: FIG 10.B.1-1. Operators from facility equipment (see FIG 25.B.10) none fit 5-95th%</p> <p>stments 15-27" in 1" lines 103-115"; operator's eyes are line". -11" above seat, aft 4" min. it have to lift self</p> <p>et 44" had min. a space 4" min. 10" had min. operators: for heavy clothing, ent, re for use with 16, heavy clothing, stretched upon by</p> <p>angle for wrap-37" max. 0.E.1. over 180° min. ion avoided, it if possible. 0.E.3.</p> <p>with consoles, while (permanent) 50" F (45" F) to charge an crew, min/man min v-2. turn: FIG 10.F.1. ment does not de-iveness. 0.F.2-8. coat: 0.20 min. an limits: X, Y, Z, 1. limits, toxicity, limit values, 10.G.1. as FIG 10.G.3. ce provided, if temp exceeds died), rounded: a, moving parts, FIG 10.G.4. cessible, storage for man- surfaces to sup- lifts have mus- ds adjacent to a user. sent equipment, ally identified, as detailed, etc.</p> | <p>Direct and techniques for commu- nity information among crew- men within the workspace, between the crew and externally located individuals, and between the crew and remotely located persons. Includes antennas, where applicable.</p> <p>Microphones, headphones, headsets permit hands free operation. As resolute volume, gain controls are provided for each channel. Fast operated "Send-Receive" control when both hands busy. Handing, telephones are located for easy emergency access, time critical communications.</p> <p>Earphones, headsets easily adjusted, or communicates 5th-95th% user: FIG 25.B.4.</p> <p>Flex to communication controls is unobstructed. Workspace or commodities operators wearing earphones, headset. Radio antenna located to minimize radio-frequency hazards.</p> <p>Design Requirements (MIL-STD-1472) • User-Computer Interface Data (MIL-STD-1472C) • Guidance Data (MIL-HDBK-759, Etc.)</p> <p>Microphone, headphone, single (multi- ple) speakers: 200-4000 Hz (100-1500 Hz); dynamic range 50 dB min. Microphone: noise cancelling in 100 dB area; 10 dB rms min. Filtering, clipping is used to improve intelligibility. Binaural headsets used when ambient noise exceeds 85 dBA. Volume, gain: audible min 110 dB max; squelched. Volume/power control has detent between min volume, off. Communication equipment worn by operator is comfortable; metal parts do not contact user's skin. Headsets worn in high ambient noise provide attenuation equal to ear protective devices. Exposed metal parts grounded. System allows emergency messages top priority, does not interfere with their transmission, reception. Antennas, waveguides grounded. Speaker hears own voice in his headset in phase with his speech. Voice communication intelligibility criterion: FIG 11.H.1. Audio signals coded as to maintenance, emergency, health hazard, etc. to minimize operator's visual display search. Instructions provided for use and fault detection for communications equipment.</p> | <p>All cables, wires, lines, hoses, pipes, vents, etc., that pass from or to the test item. Plugs, sockets, quick-disconnect fittings for the above. Includes components for transport as well as for stationary use.</p> <p>Conductors are bound into cables, held by lacing tape. Long conductors, cables internal to equipment are clamped to chassis. Test cables terminating on control panel do not interfere with controls, displays. Reels, reel carts provided to handle large, heavy, long lines, cables. Covered space for cable storage. Cable clamps spaced every 12". Line, cable attachment parts reachable by user in bulky clothing. Cables are long enough to allow functioning unit to be checked conveniently or extension cables provided. Electrical plugs size, shape coded. Line fittings standardized so lines that differ in content are not interchangeable. Cables are size, shape coded for similar components.</p> <p>Hand operation or common tools used to tighten, loosen. Tighten CW; loosen CCW.</p> <p>Adequate space provided to handle cables, lines, hoses. Clearance between cables &amp; controls: 3" min. Cable, line, hose connectors operable by user wearing arctic mittens. Low overhead pipes highly visible. Manner of connection, disconnection is obvious.</p> <p>ID tapes visible at line ends, intervals near valves, vents, etc. Bands, tags, point are adjacent to valves, regulators, clean outs, flow-checks, clean outs, branch lines, at intervals &amp; where line goes thru walls, floors. Line, hose, cable color contrasts with background. Low overhead pipes highly visible. Manner of connection, disconnection is obvious.</p> <p>Number of inputs, outputs are mini- mized by grouping functions. Cables are reachable, visible. Irregular, fragile, awkward extensions removable for handling. Cables are not: pinched by doors, lids; walked on, used as handholds; bent, twisted repeatedly. Cables routed thru holes are protected by grommets, etc. Protective caps, covers, inserts are available as necessary. Pipes, hoses guarded if temp over 140°F (120°F if handled). High pressure lines have retaining chain attached to line and source. Automatic shutoffs on fuel service equipment to prevent overflow, spillage. Electric wiring routed away from lines carrying O<sub>2</sub>, flammable fluids.</p> <p>Multiple conductors color coded. Cables labeled as to which equipment, connector they belong. Lines labeled as a function, sub-function, hazard, flow: FIG 12.H.1. ID tapes encircle the line. ID tags, bands: on cold, hot lines stainless over 4"; not near intakes. ID point used on 4" min lines. Line color (symbol) (hazard) code: FIG 12.H.2 (12.H.3) (12.H.4). Dangerous voltage placarded. Hydraulic, electric: FIG 12.H.5-6.</p> | <p>Securing devices used to assemble, pack or hold on item in place. Catches, hooks, screws, bolts, nuts, latches - both quick release and tool operated. Includes fastener and connector alignment and locking devices such as lock pins, safety wires, pins, nuts, electrical plugs, and fittings.</p> <p>It is impossible to insert a wrong plug into a receptacle. Plugs, receptacles have aligning pins for insertion. Aligning pin extends beyond plug electrical pins. Plugs, receptacles arranged so aligning pins are oriented in the same relative position. Fastener, connector operating parts are easily accessible.</p> <p>Identical screw, bolt heads provided throughout: one removal tool. Fasteners handle large enough to be grasped, handled. Non-interchangeable connectors for different use. Cotter keys: snug fit, large head. Size, shape coded pins avoid mis- match: FIG 13.H.1. Connectors are physically different when lines carry different fluids.</p> <p>Bolts requiring high torque have an external-grip head. Fasteners, plugs require one turn max to tighten, loosen. Over 10 ft.-lb. torque use external-griphead; below 10 ft.-lb. use internal, external or combi- gripheads. Quick disconnect, snap action, release, twist; up to one full turn for frequent, critical use. Tighten CW; loosen CCW.</p> <p>Gross (limiting) dimensions based on 95th% (5th%) operator's hand, arm: FIG 25.B.4-5. Adequate space available to grasp connectors firmly. Adequate space to use connector wrench. Obstructions to use are removable. Connectors are separated by 0.75" (1.25" if used with bare (gloved) fingers. Mounting screws have clearance holes. Connectors visible, accessible. Labels, codes visible in connected, unconnected state. Easy visual access is provided for starting threads, pins. ID colors are readily discriminable from each other under real operational lighting.</p> <p>Number, types minimum commensu- able with stress, bending reqmts. Captive fasteners used where dropping them creates hazard; covers need frequent removal. Bolts have min number of turns. Only standard tools are used. Adapters for pin connectors can be hand tightened. Fasteners used outside are operable under all environmental conditions. Connectors are compatible with cables, lines, fasteners, mounting. Removal of plug, connector does not expose hot leads. Plug of one voltage rating cannot be inserted into the receptacle of another voltage rating. All hot contacts are sockets. Internal-gripheads only use when critical to mechanical function, personnel safety. Use captive type dust covers where necessary. Caps, inserts, covers, cases, shields provided where necessary. Receptacles marked as to voltage, phase, frequency. Connecting plugs, receptacles identified by color, size. Plugs, receptacles have stripes, arrows, etc. to show aligning pin positions. Manner of connection obvious. Non-standard operating direction is clearly marked. Plug, receptacle identification: FIG 13.H.1.</p> | <p>Components used for packaging, storage and transportation. Cartons, packing cases, boxes, bags, and covers that are not part of the item but are used for transport. Carrying cases and storage boxes specifically designed for the item, or multiples of the item, and are part of the item configuration.</p> <p>Cases lift from units rather than units lift from cases. Inflammables stored away from engines, generators, exhaust pipes. For cross country ops items secured in storage boxes or restrained by straps, brackets. Bulkheads, brackets, other units do not interfere with opening, removal of covers on units within which work is done.</p> <p>Stowed items accessible by 5-95th% personnel: FIG 25.B.1-7.</p> <p>Cases are enough larger than units they cover to prevent damage when case is removed, replaced. Tight fitting storage avoided. Containers allow for full hand, finger clearance when using opening tool. Gloved hand clearance provided: FIG 23.B.1. It is obvious when a cover is in place but not secured. Identification of package contents clearly visible.</p> <p>Guides, tracks, stops are used to facilitate handling. Accessibility of stowed equipment reflects its function, use. Fully open, closed state obvious. Material remaining is easily determined. Edges, corners on covers, cases are rounded, otherwise finished to prevent personnel injury.</p> <p>Orientation of a unit within its case is obvious or labeled. Labels, markings tell how to open, remove, position covers, cases. Labels warn of hazards, dangers within case. Storage locations labeled.</p> | <p>Common and special tools and test instruments for assembly, adjustment, calibration and alignment. Includes special maintenance equipment such as lubrication points, pouring spoons, filter tubes and nozzles.</p> <p>Cables terminating on control, display panels do not interfere with controls, displays. Test points reflect the sequence for sequential testing. Test points for adjustment are close to the controls, displays used. Special tools required for adjustment are with equipment. Test points are accessible. Test points, built-in meters used to isolate failed unit, module.</p> <p>Limiting body dimensions based on 5th% user for reaching test points: FIG 25.B.1. Test equipment fits the hand or has handle, hand support.</p> <p>Calibration, adjustment controls with limited motion have mechanical stops to prevent damage. Built-in aligning devices, other aids are used for positioning optical assemblies within instrument. Rollout racks do not shift CG to extent that could topple. Quick-release removal for optics. Stands, casters (wheels, hoist-lifting) is provided for equipment exceeding 30 lb (90 lb).</p> <p>Adequate storage provided in portable test equipment case, lid to contain leads, probes, spares, manuals, tools. Large parts are not mounted to deny access to smaller ones. Sensitive adjustment points, guarded against accidental disturbance.</p> <p>Enough test points are provided to prevent removing sub-assemblies. Special tool use minimized. Items frequently removed for test are mounted on rollout racks, slides, hinges. Knobs preferred to screwdriver for frequent adjustment. Lamp test circuits incorporated. Lamp replacement is possible with power on, from panel front. Test equipment is not overly complex, difficult to use. Electrical potentials over 300V are stepped down for test points. Tools, test leads used near high voltages are insulated. Electrical hand-held tools have 3-wire power with ground or are double insulated. Exposed surfaces of electrical hand-held tools are non-conducting or grounded. Contacts, terminals are shielded with suitable protective measures to prevent accidental contact. Test points permanently labeled, color coded. Operating instructions for portable test equipment affixed to unit, lid or compartment. Calibration reminder included with test instructions. Contacts, terminals, etc over 500V are clearly labeled. Reference scale is provided for manual adjustment. A simple check shows when equipment is out of calibration.</p> |



**SUBCLASS A**

**The conditions applicable to this class are:**

1. User conditions - body size of users and
2. Environmental conditions - weather, vibration in the use area;
3. Operational conditions - time critical conditions (blackout, NBC, noise sup different data rates, one or more users

## INDEX TO DETAILED DESIGN CONSID

[illegible]



## SENSORS & DETECTORS

ational conditions - time critical operations (quick assembly and use), combat  
itions (blockout, NBC, noise suppression) and use conditions (duration of use,  
rent data rates, one or more users, range of things or status to be sensed.

| USE                         |  | MONITOR INFORMATION FEEDBACK   |  |
|-----------------------------|--|--|--|
| SE                          | ACTIVATE/ADJUST/DEACTIVATE   | ACQUIRE/INTERPRET INFORMATION  | DETERMINE OPERATIONAL STATUS   |
| Design of the replacing and | PURPOSE: Evaluate the test item for the ease of use of those components and procedures that are required to power and adjust the sensor. | PURPOSE: Evaluate the output of the test item for the ability of intended users to understand fully the information presented. | PURPOSE: Evaluate the test item for ease and reliability of verifying operational readiness and existing status of various components. |
| on/orient.                  | MAN/ITEM TASKS   | MAN/ITEM TASKS   | MAN/ITEM TASKS   |
| tion device.                | Activate sensor.   | Activate displays.   | Identify problems.   |
|                             | Verify activation.   | Acquire/interpret sensed data.   | Isolate problems.  |
|                             | Follow safety procedures.  | Verify validity of sensed data.  |  |
| red.                        | Read instructions.   | Integrate data from different sensors.   |  |
|                             | Communicate.   | Assess data quality.   |  |
|                             | Perform dynamic checkout.  | Assess data quantity.  |  |
|                             | Perform quick deactivation.  |  |  |
|                             | Control location/position/operation/feedback of data.  |  |  |
|                             | Control rate of motion/field of view.  |  |  |

| Optics<br>(15) | Labels<br>Manuals<br>Markings<br>(1) | Controls<br>(6) | Displays<br>(8) | Accessories<br>Covers<br>Caps<br>(19) |  | Controls<br>(6) | Displays<br>(8) | Controls<br>(6) | Displays<br>(8) |
|----------------|--------------------------------------|-----------------|-----------------|---------------------------------------|--|-----------------|-----------------|-----------------|-----------------|
| A              | A                                    | A               | A               | A                                     |  | A               |                 | A               | A               |
| B              | B                                    | B               | B               | B                                     |  | B               |                 | B               | B               |
| C              |                                      | C               |                 | C                                     |  | C               |                 | C               |                 |
| D              | D                                    | D               |                 | D                                     |  | D               |                 | D               |                 |
| E              | E                                    | E               | E               | E                                     |  | E               | E               | E               | E               |
| F              | F                                    | F               | F               | F                                     |  | F               | F               | F               | F               |
| G              | G                                    | G               | G               | G                                     |  | G               | G               | G               | G               |
| H              | H                                    | H               | H               | H                                     |  | H               | H               | H               | H               |



| 13 FASTENERS   | 8 DISPLAYS  | 6 CONTROLS  | 1 LABELS, MANUALS, MARKINGS   | HUMAN FACTORS CONSIDERATIONS    |
|--|---|---|---|---------------------------------|
| <p>Securing device package or hold on catches, hooks, latches - both operated.</p> <p>Includes fastener alignment and lock pins, safety electrical plugs, or</p> | <p>Components that provide visual and auditory information to the operator concerning the status of operation.</p> <p>Provide positive indication of developing or current malfunctions.</p> <p>Displays are associated only with the item under test, not with equipment placed in or on it.</p> | <p>Components used to activate, deactivate, or control the equipment power source and to modulate the operating elements.</p> <p>Handles, grips, knobs, switches, triggers, levers, wheels, pedals and other man operated items as applicable.</p> <p>Controls are associated only with the item under test, not with equipment placed on it.</p> | <p>Provide technical guidance in the form of written material, schematics, diagrams, illustrations and instruction plates.</p> <p>Make operator aware of hazards.</p> <p>Give special guidance or instructions.</p> | <p>ENVIRONMENTAL COMPONENTS</p> |

|  |   |   |   |   |
|--|---|---|---|---|
| <p><b>A LOCATION &amp; ARRANGEMENT</b></p> <p>The positioning of a component as it affects the ability of the operator to reach, operate or manipulate it, including location of openings (accesses), cover or door operation, location of components (knobs, levers, etc.) as well as its relationship to other components.</p> <p><b>B SIZE &amp; SHAPE</b></p> <p>The maximum and/or minimum dimensions of components that are required for adequate man use, including the effects of anthropometric and special clothing (aerobic, NBC) considerations, and the shape and contour of handles, knobs and other controls to enhance both the identification and use of the component.</p> <p><b>C DIFFICULTY OF FORCE</b></p> <p>The movement and/or force required to operate or generally manipulate a component (handle, control, fastener, etc.) with emphasis on the direction of motion corresponding to the display, component, total item reaction or standard practice as well as the minimum strength required.</p> <p><b>D CLEARANCE</b></p> <p>The unobstructed space surrounding a component which allows the operator to perform required actions, the adequacy of which varies as a function of the amount of body involved (hand, fingers, arm, torso, etc.) and, where appropriate, will also include considerations such as gloves, boots, helmets, protective clothing, etc.</p> <p><b>E VISIBILITY</b></p> <p>Those aspects of a component that contribute to the operator's ability to see it clearly, including location, size, shape, color, contrast, field of view, viewing distance, reflectance, and illumination.</p> <p><b>F USE CONDITIONS</b></p> <p>Those aspects of a component that pertain to its operational status before, during and after use, as well as the maintenance of an acceptable environment in the workspace areas.</p> <p><b>G SAFETY</b></p> <p>Those aspects of a component that could cause injury to the operator or other personnel, including preventative aspects for bad weather or reduced visibility, accidental contact with electrical, temperature, chemical, radiation and pressurization hazards, and danger to sight and hearing, particularly under the conditions of alert or battle stress.</p> <p><b>H OPERATING PROCEDURES</b></p> <p>Those operational and informational aspects affecting or improving man performance as found in equipment design for use as well as job aids, checklists, training texts, troubleshooting guides and repair manuals with specific attention to the safety aspects when using the components.</p> | <p>Controls, displays, etc are clearly, appropriately labeled except where use is obvious.</p> <p>Labels placed on or near items they identify.</p> <p>Do not cover other information.</p> <p>Label is not behind control.</p> <p>Label location consistent.</p> <p>ID labels not obscured by components on flattest surface; on main chassis min coverage by grime not easily removed.</p> <p>Character height determined by distance read, luminance FIG 1.B.1.</p> <p>Group label characters larger than those of controls, displays which are larger than control, display position characters each by 25% min.</p> <p>Letter, numeral styles FIG 1.B.2-4.</p> <p>Letter, numeral width: "M" &amp; "W" h/w = 5/16; "I" &amp; "l" are 1 stroke width.</p> <p>Stroke width for black (white) characters on light (black) backgrounds 1/16 (1/7-1/8) of height.</p> <p>Spacing between characters (words) one stroke (character) width min.</p> <p>Line spacings: 1/2 character height.</p> <p>Counter numeral h/w ratio = 1:1 (except 1; separation = 1/2 to 3/4 w).</p> <p>Optical projections all caps, stroke width 1/16 to 1/8 h/w exceeds 15 minutes visual angle.</p> <p>Thumbwheel numeral h/w ratio = 3/2; h/w = 8/5 stroke width internally (externally) illuminated = 10:1 (5:1).</p> <p>Abbreviations all caps, no periods.</p> <p>Extended copy uses lower case.</p> <p>Label characteristics determined by illumination level, color.</p> <p>Labels easily, accurately read at operational reading distance, vibration, light levels, environmental conditions.</p> <p>Labels are sharp with high or color contrast.</p> <p>With illumination above 1 ft-Cd black letters, light background.</p> <p>Dark adaptation letters visible, do not interfere with night vision.</p> <p>Chart readings FIG 6.C.3.</p> <p>Label characteristics accuracy required: time available; distance; light level; color; criticality of function; consistency of design.</p> <p>Labels on production equipment are as durable as the equipment.</p> <p>Labels for prototype equipment easily affixed, altered, removed.</p> <p>Labels not covered by other units nor obscured by grease, dirt.</p> <p>Markings, tags are as permanent, washable as equipment.</p> <p>Vertical labels used only when labels are not critical for personal safety performance.</p> <p>Electrical receptacles marked with voltage, phase, frequency.</p> <p>Pipe, hose, tube lines clearly labeled as to contents, pressure, temperature, hazards.</p> <p>Warning placards illuminated.</p> <p>Placards adjacent to hazards.</p> <p>Abbreviations are standard (MIL-STD-122); new OK if obvious.</p> <p>Trade names, irrelevant info do not appear on labeling.</p> <p>Labels concise; min redundancy.</p> <p>Abstract symbol only if meaningful.</p> <p>Words familiar to user.</p> <p>Hand grasp areas identified.</p> | <p>Control relationship to its display is apparent, compatible.</p> <p>Functionally related controls are grouped together.</p> <p>Control groups, sequential operations have left-to-right and/or top-to-bottom order of use.</p> <p>Controls in functional groups are located in accordance with operational sequence and/or function.</p> <p>Controls oriented to operator.</p> <p>Can not accidentally be moved.</p> <p>Recurring groups similar thru system.</p> <p>Rotary size, shape: FIG 6.H.1-A.</p> <p>Linear size, shape: FIG 6.H.1-B.</p> <p>Controls have non-slip surfaces.</p> <p>Gross (limiting) (adjustable) dimensions based on 95th% (5th%) ((5-95th%)) operator.</p> <p>Linear size, shape: FIG 6.H.2-18.</p> <p>Display interface controllers size, shape: FIG 6.B.19-21.</p> <p>Miniature controls used only under space constraints; size &amp; separation minimum.</p> <p>Adequate control response feedback.</p> <p>Conventional control movements: FIG 6.C.3.</p> <p>Push valves open CCW.</p> <p>Forces, displacements (including miniature controls): FIG 6.B.1-21.</p> <p>High force controls: FIG 6.C.1-2.</p> <p>Free from backlash.</p> <p>Switches: no stop between positions; resistance increases until snaps into position.</p> <p>Display interface controllers force, displacements: FIG 6.B.19-21.</p> <p>Control spacing min: FIG 6.D.1; blind operation, 5" min.</p> <p>Rotary separation: FIG 6.H.1-B.</p> <p>Linear separations: FIG 6.H.2-18.</p> <p>Compatible with hardware used.</p> <p>Range of control action does not interfere with other controls.</p> <p>Larger diameter concentric control is used for the fine adjustment.</p> <p>Display interface controllers clearances: FIG 6.B.19-21.</p> <p>Shape coded controls visually, tactually identifiable.</p> <p>Color contrasts with background.</p> <p>Ambient light color determines usable control colors.</p> <p>Reference line has 50% min contrast with control color.</p> <p>Pointer parallax error between reference marks: 25% min.</p> <p>Pointers differentiated for each knob of grouped set.</p> <p>Display interface controllers clearances: FIG 6.B.17-19.</p> <p>Precision of control manipulation is consistent with that of system.</p> <p>Selected, distributed so none of user's limbs are overburdened.</p> <p>Usable in time required despite inadvertent operation protection.</p> <p>(f) ratios: large (small) for small (large) range of display movement.</p> <p>Recommended manual controls: FIG 6.F.1.</p> <p>In bracketing, knobs swings thru 10-70° are around target value.</p> <p>Shape coding free of sharp edges.</p> <p>Critical controls are not susceptible to accidental movement.</p> <p>Controls that initiate hazardous operations require prior operation of a latching control.</p> <p>Emergency controls located near tripped warning display/reset hand.</p> <p>Minimum decoding required.</p> <p>Operating instructions provided except where use is obvious.</p> <p>Diagrams used where possible.</p> | <p>Display relationship to control is apparent; determines control used, equipment displayed.</p> <p>Functionally related units grouped.</p> <p>Displays, groups have left-to-right and/or top-to-bottom order of use.</p> <p>Displays located so they can be read to the required degree of accuracy.</p> <p>Lighted control indicators are unambiguously associated with controls.</p> <p>Emergency, critical, important displays located in 30° cone about line of sight.</p> <p>Display viewing distances: 13-28".</p> <p>Pointer extends to but does not obscure or exceed index mark width.</p> <p>Pointers are close to dial to eliminate parallax, shadows.</p> <p>Controls, flags, printers, plotters: FIG 6.B.1.</p> <p>CRT target visual angle exceeds 2.0 minutes, 10 lines of resolution distance 16" (10" min).</p> <p>Design Requirements (MIL-STD-1472)</p> <p>User-Computer Interface Data (MIL-STD-1472C)</p> <p>Guidance Data (MIL-HDBK-759, Etc.)</p> <p>Display face to line of sight exceeds 45° min parallax, reflection.</p> <p>Frequently used displays grouped in optimal visual zones: FIG 6.E.1.</p> <p>Illumination uniform: FIG 6.E.3.</p> <p>Indicator lights show response, used sparingly, visible.</p> <p>Contrast, luminance exceeds 50%.</p> <p>Flashing lights: 3-5 flashes/sec.</p> <p>Color coding used where possible; unused scales covered.</p> <p>Illumination balanced full on to off.</p> <p>Flashing lights synchronized.</p> <p>Display precision, response is consistent with that of system.</p> <p>Information displayed: Clear, specific, precise, unambiguous; not redundant, degraded by vibration; timely.</p> <p>Lights show functions: FIG 6.F.1.</p> <p>Scales: linear, start at 0, use whole numbers, 2 pointers max, numerals oriented upright.</p> <p>Mechanical types: FIG 6.F.2.</p> <p>Audio signal evaluations: FIG 6.F.3.</p> <p>Audio, verbal warnings: 20 dB min above background.</p> <p>Failure immediately apparent.</p> <p>Signal absence does not mean "go".</p> <p>Indicator light color coding for emergency, warning, summation, etc: FIG 6.F.1; master lights set apart.</p> <p>Audio warnings transmitted to both earphones and work area.</p> <p>Audio signal action segment specifies nature of problem.</p> <p>Prohibited, persistent signals are not used: FIG 6.C.1.</p> <p>Audio warning durations min of 8 sec until corrective action taken.</p> <p>Minimum decoding required.</p> <p>Trademarks, irrelevant information, etc do not appear on panel face.</p> <p>Coding techniques uniform facilitate discrimination, identification, relationship, criticality.</p> <p>Auditory displays used where vision overburdened, degraded; redundancy desirable; warning, cue needed.</p> <p>Verbal warnings: intelligible, apt.</p> <p>Audio warnings use standard signals.</p> <p>Labels: functionally basic; well located; graduated in size.</p> <p>Display pointers are aligned for common stable values.</p> <p>Pointer size, shape: 1 ft, 6.5:1-A.</p> <p>Circular dial: FIG 6.F.X.</p> <p>Display pointer tip same color as marks.</p> <p>Stacked, alternately presented legends visible.</p> <p>Pointer tip same color as marks.</p> <p>Display changes represent functional state.</p> <p>Transilluminated other displays: FIG 6.F.4-5.</p> <p>Transilluminated indicators display system status, immediate actions, adjustment functions.</p> <p>Operator presumption in a crew system allowed only for mission survival.</p> <p>Priority information obvious.</p> <p>Recommended manual controls: FIG 6.F.1.</p> <p>Auditory displays have test device.</p> <p>Auditory displays volume adjustable.</p> <p>Operator and maintainer information not combined unless compatible for both uses.</p> | <p>It is impossible plug into a receptacle.</p> <p>Plugs, receptacle for insertion.</p> <p>Aligning pin electrical pins.</p> <p>Plugs, receptacle pins are or relative position.</p> <p>Fastener, cone are easily access.</p> <p>Alignment aids.</p> <p>Parts for fasteners.</p> <p>Identical screw, throughout one.</p> <p>Fastener heads grasped, handled.</p> <p>Non-interchange different use.</p> <p>Cotter keys: snu.</p> <p>Fasteners, plug max to tighten.</p> <p>Over 10 ft.-lb. griphed below not, external or.</p> <p>Quick disconnect release, twist for frequent, cr.</p> <p>Tighten CW; loo.</p> <p>Gross (limiting) 95th% (5th%) of FIG 25.3.4-5.</p> <p>Adequate space connectors firm.</p> <p>Adequate space wrench.</p> <p>Obstructions to connectors are (1.25") if used fingers.</p> <p>Mounting screw holes.</p> <p>Connectors visible.</p> <p>Labels, codes v unconnected side.</p> <p>Easy visual access.</p> <p>Visual threads, ID colors are r from each other for lighting.</p> <p>Number, type r rate with stress.</p> <p>Captive fastener pin; they are need frequent re.</p> <p>Bolts have min r.</p> <p>Only standard r.</p> <p>Adapters for pin hand tightened.</p> <p>Fasteners used under all environ.</p> <p>Connectors are ble, lines, faste.</p> <p>Removal of plug expose hot leads.</p> <p>Plug of one volt inserted into the other voltage r.</p> <p>All hot contacts.</p> <p>Use captive typ necessary.</p> <p>Internal-griphe critical to mech safety.</p> <p>Caps, inserts, r provided where r.</p> <p>Receptacles ma phase, frequency.</p> <p>Connecting plug fitted by color, s.</p> <p>Plugs, receptacle rows, etc to the front.</p> <p>Member of conn clearly marked.</p> <p>Plug, receptacle 13.H.1.</p> |
|--|---|---|---|---|



|  | 13 FASTENERS, CONNECTIONS   | 14 HANDLES   | 15 OPTICS   | 17 PACKAGING  | 19 ACCESS, COVERS, CAPS  |
|--|---|--|---|---|--|
| to the operator<br>itions.<br>d with equipment   | <p>Securing devices used to assemble, package or hold an item in place.</p> <ul style="list-style-type: none"> <li>Catches, hooks, screws, bolts, nuts, latches - both quick release and tool operated.</li> <li>Includes fastener and connector equipment and locking devices such as lock pins, safety wires, pins, nuts, electrical plugs, and fittings.</li> </ul>  | <p>The special or inherent devices used to grasp, hold, grip or lift an item for lifting, moving, steadying or aiming.</p> <ul style="list-style-type: none"> <li>Handles, knobs, projections, straps, etc.</li> <li>Involves roughened or non-slip surface when used for handling.</li> <li>Check also for the lack of handles.</li> </ul>  | <p>Components that use the human eye for sighting, aiming or viewing.</p> <ul style="list-style-type: none"> <li>Includes eyepieces, reticles, filters, sighting mechanisms, range finders, viewers.</li> <li>Excludes visual displays.</li> </ul>  | <p>Components used for packaging, storage and transportation.</p> <ul style="list-style-type: none"> <li>Cases, packing cases, boxes, bags, and covers that are not part of the item but are used for transport.</li> <li>Carrying cases and storage boxes specifically designed for the item, or multiples of the item, and are part of the item configuration.</li> </ul>   | <p>Those openings in an item that allow manipulation of controls, connection and disconnection of fasteners, visual checking of displays or components utilizing test points, and inserting or removing materials.</p> <ul style="list-style-type: none"> <li>Included is the access covering, if any.</li> </ul>  |
| are aligned for<br>es.   | <ul style="list-style-type: none"> <li>It is impossible to insert a wrong plug into a receptacle.</li> <li>Plugs, receptacles have aligning pins for insertion.</li> <li>Aligning pin extends beyond plug electrical pins.</li> <li>Plugs, receptacles arranged so aligning pins are oriented in the same relative position.</li> <li>Fastener, connector operating parts are easily accessible.</li> <li>Alignment aids, self alignment of parts for fastening.</li> <li>Identical screw, bolt heads provided throughout one removal tool.</li> <li>Fastener heads large enough to be grasped, handled.</li> <li>Non-interchangeable connectors for different use.</li> <li>Cutter keys: snug fit, large head.</li> </ul>  | <ul style="list-style-type: none"> <li>Handles, grasp areas are located relative to the CU.</li> <li>Hinged, fold-out handles have a stop position: one hand operation.</li> <li>Two handles min. or one handle/ grasp area for units 10 lbs. or more.</li> <li>Handles located so that lifting is at arm distance from body.</li> <li>Lift points on large items are equidistant from the CG.</li> <li>Handles reachable by 5th% user wearing bulky, restrictive clothing.</li> <li>Bar, T-bar, J-bar, recessed handles FIG 14.B.1.</li> <li>Hand shaped handle used on item carried frequently or for long periods.</li> </ul>   | <ul style="list-style-type: none"> <li>Optical instruments are oriented to give operator a comfortable angle of view.</li> <li>Purging, charging fittings are accessible for maintenance.</li> <li>Components requiring frequent maintenance, special tools are readily accessible.</li> <li>Interpupillary distance between eyepieces adjustable 50-76 mm.</li> <li>Eyecups prevent stray light from entering eyes.</li> <li>Built-in collimation for field adjust.</li> <li>Gross (limiting) dimensions based on 95th (5th%) user: FIG 25.B.6.</li> <li>Field of view is compatible with use, optical-mechanical limits.</li> <li>Entrance pupil: magnification x exit pupil diameters.</li> <li>Reticle lines: thin enough not to block targets thick enough to be easily seen.</li> <li>Eyecup specifications: FIG 15.B.1.</li> <li>Rifle, pistol sight (monocular, binocular) 4 (8) power max.</li> </ul>  | <ul style="list-style-type: none"> <li>Cases lift from units rather than units lift from cases.</li> <li>Inflammables stowed away from engines, generators, exhaust pipes.</li> <li>For cross country ops items secured in storage boxes or restrained by straps, brackets.</li> <li>Storage available for individual weapons, small-arms ammo, rations, helmets, etc.</li> <li>Stowed items accessible by 5-95th% personnel: FIG 25.B.1-7.</li> </ul>                  | <ul style="list-style-type: none"> <li>Sliding, rotating, hinged units open, rotate their full distance, remain in place without hand support.</li> <li>Covers have mounting holes large enough to permit the attaching screws to pass without perfect alignment.</li> <li>Covers not completely removable are self supporting.</li> <li>Rubber strapping, sealing material located so user will not damage it when cover is removed.</li> <li>Gross (limiting) dimensions based on 95th (5th%) user: FIG 25.B.1-7.</li> <li>Hand, arm, finger access: FIG 19.B.1.</li> <li>Requirements to see, work within access determines opening size.</li> <li>Attached to user: FIG 25.B.8.</li> </ul>         |
| 19, 20, 1-8,<br>B.F.X.   | <ul style="list-style-type: none"> <li>Fasteners, plugs require one turn max to tighten, loosen.</li> <li>Over 10 ft.-lb. torque use external-griphead; below 10 ft.-lb. use internal, external or combo gripheads.</li> <li>Quick disconnect, snap action, release, twist: up to one full turn for frequent, critical use.</li> <li>Tighten CW; loosen CCW.</li> </ul>   | <ul style="list-style-type: none"> <li>Weight limits for one man lift: FIG 14.C.1. If shape is convenient, handles are provided, lift is not repeated, item is not carried.</li> <li>Horizontal push, pull force limits: FIG 14.C.2.</li> <li>Handle, grasp area force limits: FIG 6.C.1.</li> <li>Two-man lift values are twice one-man lift only if item configuration convenient; neither man exceeds one-man limit.</li> </ul>   | <ul style="list-style-type: none"> <li>2 eyepieces used during low light level viewing that exceeds 1 minute.</li> <li>Gross (limiting) dimensions based on 95th (5th%) user: FIG 25.B.6.</li> <li>Magnification difference between the two eyes 2% max.</li> <li>Difference in amount of light between the two eyes 5% max.</li> </ul>   | <ul style="list-style-type: none"> <li>Structural members do not prevent access to components.</li> <li>Replaceable items are not placed in a manner which makes them difficult to remove.</li> <li>Small covers hinge at bottom, open down.</li> <li>Cover latch requires positive force to open, is within capability of 5th% user: FIG 6.C.1.</li> <li>Caps tighten CW, loosen CCW.</li> </ul>   | <ul style="list-style-type: none"> <li>Openings are large enough to permit required operations.</li> <li>Allowance is made for gloved hand in externally located access.</li> <li>Open covers do not interfere with controls, displays.</li> </ul>   |
| same color as<br>v presented<br>as marks.  | <ul style="list-style-type: none"> <li>Gross (limiting) dimensions based on 95th (5th%) operator's hand, arm: FIG 25.B.4-5.</li> <li>Avoidable space available to grasp connectors firmly.</li> <li>Avoidable space to use connector wrench.</li> <li>Distractions to use are removable.</li> <li>Connectors are separated by 0.75" (1.25") if used with bare (gloved) fingers.</li> <li>Mounting screws have clearance holes.</li> <li>Connectors visible, accessible.</li> <li>Labels, codes visible in connected, unconnected state.</li> <li>Easy visual access is provided for starting threads, pins.</li> <li>ID colors are readily discriminable from each other under real operational lighting.</li> </ul>  | <ul style="list-style-type: none"> <li>Handles have at least 26" clearance from obstructions.</li> <li>Straps, buckles do not interfere with operation of item.</li> <li>Handles color coded to distinguish from similar shaped items.</li> <li>Handles are visible from the grasping, lifting position.</li> </ul>  | <ul style="list-style-type: none"> <li>Eye relief is at least 15 mm.</li> <li>Eyecups, headrests: compatible with helmets, masks, etc.</li> <li>Slip scales usable by 5-95th% hands no tools.</li> <li>Line reticles preferred over those with 1, 2 or 3 control spots.</li> <li>Small cross or circle preferred over dot for reticle.</li> <li>Ring preferred over a spot for reticle.</li> <li>Optic components accommodate arctic headwear, headwear.</li> <li>Reticles are illuminated for night, twilight operations.</li> <li>Illumination: even blue color not used; dimming provided; level remains fixed under vibrations.</li> <li>Level vials, scales, pointers are readily visible, illuminated for low light condition use.</li> <li>Lighting minimally affects the dark adaptations of observer.</li> <li>Luminous transmission exceeds 50%; parallel limited.</li> <li>Filters used for high light levels.</li> <li>Adjustment of eyes beyond normal ability is not required.</li> <li>Magnification is high enough for required application.</li> </ul> | <ul style="list-style-type: none"> <li>Cases are enough larger than units they cover to prevent damage when case is removed, replaced.</li> <li>Tight fitting storage avoided.</li> <li>Containers allow for full hand, finger clearance when using opening tool.</li> <li>Gloved hand clearance provided: FIG 23.B.1.</li> <li>Identification of package contents clearly visible.</li> </ul>  | <ul style="list-style-type: none"> <li>Visual access cover preferences: none, transparent, break-resistant glass, quick opening metal.</li> <li>It is obvious when a cover is in place but not secured.</li> <li>Visual access only for components requiring a visual check.</li> <li>Instructions visible when access cover is open.</li> <li>Openings allow visibility of internal components while operator performs tests.</li> </ul>  |
| present func-<br>tion display:<br>ators display<br>date actions,<br>in a crew sys-<br>r mission sur-<br>vive, a<br>ual controls:<br>test device,<br>volume adjust-<br>ment | <ul style="list-style-type: none"> <li>Number, types minimum commensurate with stress, handling needs.</li> <li>Captive fasteners used where dropping them creates hazards covers need frequent removal.</li> <li>Bolts have min number of turns.</li> <li>Only standard tools are used.</li> <li>Adapters for pin connectors can be hand tightened.</li> <li>Fasteners used outside are operable under all environmental conditions.</li> <li>Connectors are compatible with cables, lines, fasteners, mounting.</li> <li>Removal of plug, connector does not expose hot leads.</li> <li>Plug of one voltage rating cannot be inserted into the receptacle of another voltage rating.</li> <li>All hot contacts are sockets.</li> <li>Use captive type dust covers where necessary.</li> <li>Internal-gripheads: only use when critical to mechanical function, personnel safety.</li> <li>Caps, inserts, covers, cases, shields provided where necessary.</li> <li>Receptacles marked as to voltage, phase, frequency.</li> <li>Connecting plugs, receptacles identified by color, size.</li> <li>Plugs, receptacles have stripes, arrows, etc to show aligning pin positions.</li> <li>Manner of connection obvious.</li> <li>Non-standard operating direction is clearly marked.</li> <li>Plug, receptacle identification: FIG 14.C.1.</li> </ul> | <ul style="list-style-type: none"> <li>Handles also guard against inadvertent control operation; protect meter faces used as support, stand, hanging or locking device.</li> <li>Removable, carried units provided with handles, other suitable means for grasping, handling, carrying.</li> <li>Hand grips have non-slip surface.</li> <li>Carried item will ride clear of legs of personnel.</li> <li>Handle/grasp surfaces are not thermally/electrically conductive.</li> <li>Insulated handles used on hot items.</li> <li>Non-recessed handles do not injure personnel, entangle clothing, damage equipment.</li> <li>Edges rounded; attaching screws recessed.</li> </ul> | <ul style="list-style-type: none"> <li>Resolutions: 60 sec of arc min.</li> <li>Oculars are matched pairs.</li> <li>Instruments needing steady eye usage have brow pads.</li> <li>Level vials, scales, pointers are protected from damage.</li> <li>Focusing: -4 to +2 diopters for over 4-power.</li> <li>Eyecups are made of soft rubber or equivalent material.</li> <li>No skin contact with metal parts.</li> </ul>  | <ul style="list-style-type: none"> <li>Guides, tracks, steps are used to facilitate handling.</li> <li>Accessibility of stowed equipment reflects its function, use.</li> <li>Fully open, closed state obvious.</li> <li>Material remaining is easily determined.</li> <li>Edges, corners on covers, cases are rounded, otherwise finished to prevent personnel injury.</li> </ul>  | <ul style="list-style-type: none"> <li>Access covers are equipped with grasp areas for opening.</li> <li>Physical access cover preferences: none, sliding, hinged, quick-opening.</li> <li>Captive fasteners used when periodic removal is required.</li> <li>Cover fasteners self lock for closing with audible snap.</li> <li>Replaceable caps captive.</li> <li>Sliding doors, caps lock positively.</li> <li>Edges, corners on covers, cases are rounded to prevent injury.</li> <li>Hazardous voltage behind access cover is de-energized with an interlock attached to cover.</li> <li>Access over dangerous mechanical, electrical component has an internal light, warning on door.</li> </ul> |
| trainer inter-<br>unless compat-   | <ul style="list-style-type: none"> <li>Items exceeding one man lift (FIG 14.C.1) are labeled with weight, lift limits.</li> <li>Hand grasp areas identified.</li> </ul>   | <ul style="list-style-type: none"> <li>Components, parts are labeled.</li> <li>If periodic purging, charging is required an instruction plate indicating time interval, pressure is attached.</li> </ul>   | <ul style="list-style-type: none"> <li>Orientation of a unit within its case is obvious or labeled.</li> <li>Labels, markings tell how to open, remove, position covers, cases.</li> <li>Labels warn of hazards, dangers within case.</li> <li>Storage locations labeled.</li> </ul>  | <ul style="list-style-type: none"> <li>Cover opening method is obvious or instructions are displayed on outside of cover.</li> <li>Accesses are labeled with warning sign advertising of hazards within, precautions needed.</li> <li>Labels indicate function of units behind enclosure, access.</li> <li>Labels, instructions are properly oriented when cover, case, door is open.</li> <li>Labels indicate how service equipment is oriented, connected.</li> </ul> |  |



TEST FUNCTION \_\_\_\_\_

TEST ITEM CLASS IV \_\_\_\_\_

SUBCLASS B \_\_\_\_\_

INFORMATION/CONTROL \_\_\_\_\_

**OBJECTIVE:** Evaluate the effectiveness and safety of the design of information systems and command-control systems to enable the operator or crew to enter and leave the station, prepare for operations, and operate the station. The HFE subtest should consider evaluation of user performance and safety for these functions under conditions representative of those expected in actual use.

The conditions applicable to this class are:

1. User conditions - body size, clothing, the users;
2. Environmental conditions - weather, vibration;
3. Operational conditions - time critical conditions (data rates, alternate appropriate different operational requirements).

| ENTER/LEAVE STATION  |   | PREPARE FOR OPERATION   |  |
|--|---|---|--|
| ENTER/LEAVE  | TAKE POSITION   | CONFIGURE STATION   | PERFORM  |
| <p><b>PURPOSE:</b> To evaluate the design of doors and other access covers for adequacy in enabling operators to open and close them from normal approach locations inside or outside of workspace.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Grasp and operate door control.</p> <p>Push/pull/slide door open/closed.</p> | <p><b>PURPOSE:</b> To evaluate the normal operating position for ease of entry and exit in both nominal and contingency conditions.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Step into/out of work area.</p> <p>Take/leave seat.</p> <p>Move to/from standing operator position.</p> <p>Remove excess clothing (rain/NBC/arctic).</p> <p>Stow clothing/tools/packs/other encumbrances.</p> | <p><b>PURPOSE:</b> Evaluate the design of components and procedures for ease of preparing the station for use.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Adjust environment controls.</p> <p>Select modes of operation.</p> <p>Integrate with other operators.</p> <p>Establish command links.</p> <p>Make connections.</p> <p>Follow procedures.</p> <p>Communicate.</p> <p>Interact with support systems.</p> | <p><b>PURPOSE:</b> Evaluate the design of components and procedures for ease of preparing the station for use.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Check control settings.</p> <p>Check data return.</p> <p>Check data return.</p> <p>Check links.</p> <p>Verify operations.</p> |

INDEX TO DETAILED DESIGN CONSIDERATIONS

| Test Item Components<br>HUMAN FACTORS<br>CONSIDERATIONS | Doors<br>Hatches<br>Passages<br>(4) | Workspace<br>(10) | Labels<br>Manuals<br>Markings<br>(1) | Workspace<br>(10) | Labels<br>Manuals<br>Markings<br>(1) | Controls<br>(6) | Displays<br>(8) | Fastener<br>Connectors<br>(13) | Labels<br>Manuals<br>Markings<br>(1) |
|---|-------------------------------------|-------------------|--------------------------------------|-------------------|--------------------------------------|-----------------|-----------------|--------------------------------|--------------------------------------|
| A. LOCATION & ARRANGEMENT                               | A                                   | A                 | A                                    | A                 | A                                    | A               | A               | A                              | A                                    |
| B. SIZE & SHAPE   | B                                   | B                 | B                                    | B                 | B                                    | B               | B               | B                              | B                                    |
| C. DIRECTION & FORCE                                    | C                                   | C                 | C                                    | C                 | C                                    | C               | C               | C                              | C                                    |
| D. CLEARANCE  | D                                   | D                 | D                                    | D                 | D                                    | D               | D               | D                              | D                                    |
| E. VISIBILITY   | E                                   | E                 | E                                    | E                 | E                                    | E               | E               | E                              | E                                    |
| F. USE CONDITIONS                                       | F                                   | F                 | F                                    | F                 | F                                    | F               | F               | F                              | F                                    |
| G. SAFETY   | G                                   | G                 | G                                    | G                 | G                                    | G               | G               | G                              | G                                    |
| H. OPERATING PROCEDURES                                 | H                                   | H                 | H                                    | H                 | H                                    | H               | H               | H                              | H                                    |



## INFORMATION/COMMAND-CONTROL SYSTEMS

- 1. User conditions - body size, clothing, number of operators, and general skill level of the users;
- 2. Environmental conditions - weather, climate, illumination levels, and noise and vibrations;
- 3. Operational conditions - time critical operations (emergency aegress) and use conditions (data rates, alternate tactical situations, time on station, range of appropriate different operational requirements and constraints).

| PREPARE FOR OPERATION                     |   | OPERATE STATION   |   |
|---|---|---|---|
| ACTION                                    | PERFORM CHECKOUT  | ACQUIRE/INTERPRET INFORMATION   | CONTROL/ADJUST OPERATIONS   |
| <p>design of com-<br/>or ease of pre-</p> | <p>PURPOSE: Evaluate the test item for ease and reliability of verifying operational readiness and existing status of various components.</p> | <p>PURPOSE: Evaluate the output of the test item for the ability of intended users to understand fully the information presented.</p> | <p>PURPOSE: Evaluate the test item for ease of use of those components that contribute to the operational readiness of the station.</p> |
| <p>als.</p>                               | <p>MAN/ITEM TASKS</p> <p>Check control settings.</p>  | <p>MAN/ITEM TASKS</p> <p>Obtain/monitor continuous data.</p>  | <p>MAN/ITEM TASKS</p> <p>Activate system/change control settings.</p>   |
| <p>itors.</p>                             | <p>Check data return quality.</p>   | <p>Obtain/monitor discrete data.</p>  | <p>Change system configuration.</p>   |
|   | <p>Check data return format.</p>  | <p>Obtain/monitor status data.</p>  | <p>Change software.</p>   |
|   | <p>Check links.</p>   | <p>Obtain verification data.</p>  | <p>Input discrete commands.</p>   |
|   | <p>Verify operational readiness.</p>  | <p>Identify/isolate problems.</p>   | <p>Input continuous control.</p>  |
|   |   | <p>Assess requirement to modify operations.</p>   | <p>Monitor computer/communications/sensor systems.</p>  |
| <p>ITTS.</p>                              |   |   |   |

[illegible]



## DESIGN CONSIDERATIONS

### HUMAN FACTORS CONSIDERATIONS

#### A. LOCATION & ORIENTATION

The positioning of a component as it affects the ability of the operator to reach, see, or manipulate it, including the amount of space required, the ease of access, the location of the component, the location of the controls, the location of the displays, etc., as well as its relationship to other components.

#### B. SIZE & SHAPE

The maximum and minimum dimensions of components that are required for adequate man use, including the effects of anthropometric and spatial planning factors, the shape and contour of handles, knobs and other controls to enhance both the identification and use of the component.

#### C. DIRECTION & FORCE

The movement and/or force required to operate or manipulate a component (handle, control, fastener, etc.), with emphasis on the direction of motion corresponding to the display, component, total item reaction or standard practice as well as the forces in strength required.

#### D. CLEARANCE

The unobstructed space surrounding a component which allows the operator to perform required actions, the degree of which varies as a function of the amount of body involved (hand, fingers, arm, torso, etc.), and, where appropriate, will also include considerations such as gloves, boots, helmets, protective clothing, etc.

#### E. VISIBILITY

Those aspects of a component that contribute to the operator's ability to see it clearly, including location, size, shape, color, contrast, field of view, viewing distance, reflectance, and illumination.

#### F. ENVIRONMENTAL CONDITIONS

Those aspects of a component that pertain to its operational status before, during and after use, as well as the maintenance of an acceptable environment in the workspace area.

#### G. SAFETY

Those aspects of a component that could cause injury to the operator or other personnel, including preventive aspects for bad weather or reduced visibility, accidental contact with electrical, temperature, chemical, radiation and pressurization hazards, and danger to sight and hearing, particularly under the conditions of alert or battle stress.

#### H. OPERATING PROCEDURES

Those operational and informational aspects affecting or improving man performance as found in equipment design handbooks as well as job aids, checklists, training texts, troubleshooting guides and repair manuals with specific attention to the safety aspects when using the components.

## 1. LABELS, MATERIALS, MARKINGS

Provide technical guidance in the form of written material, schematics, diagrams, illustrations and instruction plates. Make operator aware of hazards. Give special guidance or instructions.

- Controls, displays, etc. are clearly, appropriately labeled except where use is obvious.
- Labels placed on or near items they identify.
- Do not cover other information.
- Label is not behind control.
- Label location consistent.
- ID label: not obscured by components; on flat surface on main chassis; min coverage by grime; not easily removed.

- Character height determined by distance read, luminance: FIG 1.B.1.
- Group label characters larger than those of controls, displays which are larger than control; display position characters each by 25% min.
- Letter, numeral styles: FIG 1.B.2.4.
- Height/width ratio:  $\geq 5/3$ ; "M" & "W" are 1 stroke width with ratio:  $\geq 5/4$ ; "I" & "L" are 1 stroke width.
- Stroke width for black (white) characters on light (black) background:  $1/6$  (1/7-1/8) of height.

- Spacing between characters (words): one stroke (character) width min.
- Line spacings:  $\geq 1$  character height.
- Counter numeral h/w ratio:  $\geq 1/1$  (except 1/2 separation:  $\geq 1$  to  $1/2$  h/w).
- Optical projections: all caps, stroke width  $1/6$  to  $1/8$  h; exceeds 15 minutes visual angle.
- Thumbwheel numeral h/w ratio:  $\geq 3/2$ ; h:  $\geq 1/2$  stroke width internally (externally illuminated:  $\geq 10/1$  (5/1)).
- Abbreviations all caps, no periods.
- Extended copy uses lower case.
- Label characteristics determined by illumination level, color.
- Labels easily, accurately read at operational reading distance, vibration, light levels, environments.
- Labels are sharp with high or color contrast.
- With illumination above 1 ft-C black letters, light background.
- Dark adaptations: letters visible, do not interfere with night vision.
- Chart readings: FIG 8.L.3.

- Label characteristics: accuracy required; time available; distance; light level; color; criticality of function; consistency at design.
- Labels on production equipment are as durable as the equipment.
- Labels for prototype equipment easily affixed, altered, removed.
- Labels not covered by other units nor obscured by grease, dirt.
- Markings, tags are as permanent, washable as equipment.

- Vertical labels used only when labels are not critical for personnel safety, performance.
- Electrical receptacles marked with voltage, phase, frequency.
- Pipe, hose, tube lines clearly labeled as to contents, pressure, temperature, hazards.
- Warning placards illuminated.
- Placards adjacent to hazards.

- Abbreviations are standard (MIL-STD-12); new OK if obvious.
- Trade names, irrelevant info do not appear on labeling.
- Labels concise; min redundancy.
- Abstract symbol only if meaningful.
- Words familiar to user.
- Hand grasp areas identified.
- Axes of graphs labeled and graduated appropriately.
- Printed info directly useable; min of decoding, interpolation.

- Labels easily, accurately read at operational reading distance, vibration, light levels, environments.
- Labels are sharp with high or color contrast.
- With illumination above 1 ft-C black letters, light background.
- Dark adaptations: letters visible, do not interfere with night vision.
- Chart readings: FIG 8.L.3.

- Labels characteristics: accuracy required; time available; distance; light level; color; criticality of function; consistency at design.
- Labels on production equipment are as durable as the equipment.
- Labels for prototype equipment easily affixed, altered, removed.
- Labels not covered by other units nor obscured by grease, dirt.
- Markings, tags are as permanent, washable as equipment.

- Vertical labels used only when labels are not critical for personnel safety, performance.
- Electrical receptacles marked with voltage, phase, frequency.
- Pipe, hose, tube lines clearly labeled as to contents, pressure, temperature, hazards.
- Warning placards illuminated.
- Placards adjacent to hazards.

- Abbreviations are standard (MIL-STD-12); new OK if obvious.
- Trade names, irrelevant info do not appear on labeling.
- Labels concise; min redundancy.
- Abstract symbol only if meaningful.
- Words familiar to user.
- Hand grasp areas identified.
- Axes of graphs labeled and graduated appropriately.
- Printed info directly useable; min of decoding, interpolation.

## 4. ENVIRONMENTAL PASSAGE

Provide a means for entering and leaving the workspace. Provide openings for loading or unloading material. Components are evaluated for both normal and emergency use. Some doors serve dual purposes and must also be evaluated as steps, ramps or platforms.

- Wall hatches flush with floor where structurally possible.
- Latch handles can be reached from normal approach positions.
- Overhead hatches: latch to hold open inside (padded); 1 hand operation.
- Handles can be reached, operated by troops in bulky clothing.

- Doors: 80-84" h; 32-34" w.

- Hatch handle unlatching force: 20 lb max.
- Overhead hatch: opening force, 50 lb max; operable by user with 5th% army hand strength: FIG 6.C.1.
- Hatch opening force: 50 lb max.
- Handles operable with gloves.

- Fixed equipment is located 3" min from swept area of doors.
- Gross (limiting) dimensions based on 95th% (5th%) fully equipped user: FIG 25.B.1-7.
- Door frames 3" min from corner.
- Wall escape hatches in vehicle mounted shelters clear all obstructions.
- Exit, egress possible wearing boots.

- Passageway illumination: 10 ft-C min.
- Latch control visible initially.
- Door jamb or ceiling height allows full view of step point.
- "See thru" where possible.

- Sliding doors are not installed as the only personnel exit.
- Doors, emergency exits are easily reached, unobstructed, quick opening: 3 sec max. 10-30 lb. operating force.
- Escape openings: smooth-edged, no obstructions, permit passage with survival equipment.
- Glass in doors shatterproof.
- No hazards or obstructions in entryways or on either side.

- Color of latch handle different from that of door.
- Correct movement of latch handle diagrammed, labeled.
- Exit instructions are legible, brief, clearly worded.

- Sliding doors are not installed as the only personnel exit.
- Doors, emergency exits are easily reached, unobstructed, quick opening: 3 sec max. 10-30 lb. operating force.
- Escape openings: smooth-edged, no obstructions, permit passage with survival equipment.
- Glass in doors shatterproof.
- No hazards or obstructions in entryways or on either side.

- Color of latch handle different from that of door.
- Correct movement of latch handle diagrammed, labeled.
- Exit instructions are legible, brief, clearly worded.

## 6. CONTROLS

Components used to activate, deactivate and modify the equipment power source and to modulate the elements. Handles, grips, knobs, switches, triggers, levers, wheels, pedals and other man operated items as applicable. Controls are associated only with the item under test, not with equipment placed on it.

- Control relationship to its display is apparent, compatible.
- Functionally related controls are grouped together.
- Control groups, sequential operations have left-to-right and/or top-to-bottom order of use.
- Controls in functional groups are located in accordance with operational sequence and/or function.
- Controls are oriented to operators.
- Can not accidentally be moved.
- Recurring groups similar thru system.
- Controls used for same function on different equipment are same size.
- Rotary size, shape: FIG 6.B.1-6.
- Linear size, shape: FIG 6.B.7-13.
- Designate control response feedback.
- Gross (limiting) (adjustable) dimensions based on 95th% (5th%) (15-95th%) operator.
- Standardization of keyboards.
- PC switches: surface oriented; dimensions sufficiently high for error-free use with common styles.
- Linear size, shape: FIG 6.B.9-18.
- Designate control response feedback.
- Control motions: CW, forward, up, right produces corresponding display motion on fixed scale (or reverse motion with a moving scale, fixed pointer) with increasing reading magnitude.
- Rotary valves open CCW.
- Forces, displacements (including miniature controls): FIG 6.B.1-21.
- Free form backlash.
- Isometric joystick: deflection minimal, perceptible.
- Control spacing: min: FIG 6.D.1; blind operation, 5" min.
- Rotary separations: FIG 6.B.1-8.
- Linear separations: FIG 6.B.9-18.
- Foot switches: separated 3" horizontally, 8" vertically min um.
- XY controllers: cordless; operable with either hand.
- Display interface controllers clear: FIG 6.B.19-21.
- Larger diameter concentric control is used for the fine adjustment.

- Shape coded controls visually, tactually identifiable.
- Color contrasts with background.
- Ambient light color determines useable control color.
- Reference line has 50% min contrast with control color.
- Pointer parallax error between reference marks: 25% min.
- Thumbwheel internally lighted if ambient illumination below 1 ft-C.
- Thumbwheel readable 30° off-axis.
- Legend switch legend is legible.
- Precision of control manipulation is consistent with that of system.
- Selected, distributed so none of user's limbs are overburdened.
- Coding uniform throughout system.
- Useable in time required despite inadvertent operation protection.
- Movement oriented to operator if several stations are used.
- Control motion minimized; not cycled thru ON/OFF unnecessarily.
- Minimum use mode of horizontal or 3-position toggle switches.
- Shape coding free of sharp edges.
- Critical controls are not susceptible to accidental movement.
- Controls that initiate hazardous operations require prior operation of a locking control.
- Main power ON-OFF switch cuts all power to equipment.
- Emergency controls located near related warning display/instrument panel.
- Data manipulated without concern for internal storage.
- Control color related to display.
- Operating instructions provided except where use is obvious.
- Diagrams used where possible.
- Main power switch labeled.
- Emergency (noncritical) functional groups outlined with 3/16" red (1/16" black) border.
- Controls labeled as to function.
- Emergency entries are easily corrected.
- Internal software checks minimize user errors.

- Shape coded controls visually, tactually identifiable.
- Color contrasts with background.
- Ambient light color determines useable control color.
- Reference line has 50% min contrast with control color.
- Pointer parallax error between reference marks: 25% min.
- Thumbwheel internally lighted if ambient illumination below 1 ft-C.
- Thumbwheel readable 30° off-axis.
- Legend switch legend is legible.
- Precision of control manipulation is consistent with that of system.
- Selected, distributed so none of user's limbs are overburdened.
- Coding uniform throughout system.
- Useable in time required despite inadvertent operation protection.
- Movement oriented to operator if several stations are used.
- Control motion minimized; not cycled thru ON/OFF unnecessarily.
- Minimum use mode of horizontal or 3-position toggle switches.
- Shape coding free of sharp edges.
- Critical controls are not susceptible to accidental movement.
- Controls that initiate hazardous operations require prior operation of a locking control.
- Main power ON-OFF switch cuts all power to equipment.
- Emergency controls located near related warning display/instrument panel.
- Data manipulated without concern for internal storage.
- Control color related to display.
- Operating instructions provided except where use is obvious.
- Diagrams used where possible.
- Main power switch labeled.
- Emergency (noncritical) functional groups outlined with 3/16" red (1/16" black) border.
- Controls labeled as to function.
- Emergency entries are easily corrected.
- Internal software checks minimize user errors.

- Shape coded controls visually, tactually identifiable.
- Color contrasts with background.
- Ambient light color determines useable control color.
- Reference line has 50% min contrast with control color.
- Pointer parallax error between reference marks: 25% min.
- Thumbwheel internally lighted if ambient illumination below 1 ft-C.
- Thumbwheel readable 30° off-axis.
- Legend switch legend is legible.
- Precision of control manipulation is consistent with that of system.
- Selected, distributed so none of user's limbs are overburdened.
- Coding uniform throughout system.
- Useable in time required despite inadvertent operation protection.
- Movement oriented to operator if several stations are used.
- Control motion minimized; not cycled thru ON/OFF unnecessarily.
- Minimum use mode of horizontal or 3-position toggle switches.
- Shape coding free of sharp edges.
- Critical controls are not susceptible to accidental movement.
- Controls that initiate hazardous operations require prior operation of a locking control.
- Main power ON-OFF switch cuts all power to equipment.
- Emergency controls located near related warning display/instrument panel.
- Data manipulated without concern for internal storage.
- Control color related to display.
- Operating instructions provided except where use is obvious.
- Diagrams used where possible.
- Main power switch labeled.
- Emergency (noncritical) functional groups outlined with 3/16" red (1/16" black) border.
- Controls labeled as to function.
- Emergency entries are easily corrected.
- Internal software checks minimize user errors.

- Shape coded controls visually, tactually identifiable.
- Color contrasts with background.
- Ambient light color determines useable control color.
- Reference line has 50% min contrast with control color.
- Pointer parallax error between reference marks: 25% min.
- Thumbwheel internally lighted if ambient illumination below 1 ft-C.
- Thumbwheel readable 30° off-axis.
- Legend switch legend is legible.
- Precision of control manipulation is consistent with that of system.
- Selected, distributed so none of user's limbs are overburdened.
- Coding uniform throughout system.
- Useable in time required despite inadvertent operation protection.
- Movement oriented to operator if several stations are used.
- Control motion minimized; not cycled thru ON/OFF unnecessarily.
- Minimum use mode of horizontal or 3-position toggle switches.
- Shape coding free of sharp edges.
- Critical controls are not susceptible to accidental movement.
- Controls that initiate hazardous operations require prior operation of a locking control.
- Main power ON-OFF switch cuts all power to equipment.
- Emergency controls located near related warning display/instrument panel.
- Data manipulated without concern for internal storage.
- Control color related to display.
- Operating instructions provided except where use is obvious.
- Diagrams used where possible.
- Main power switch labeled.
- Emergency (noncritical) functional groups outlined with 3/16" red (1/16" black) border.
- Controls labeled as to function.
- Emergency entries are easily corrected.
- Internal software checks minimize user errors.

- Shape coded controls visually, tactually identifiable.
- Color contrasts with background.
- Ambient light color determines useable control color.
- Reference line has 50% min contrast with control color.
- Pointer parallax error between reference marks: 25% min.
- Thumbwheel internally lighted if ambient illumination below 1 ft-C.
- Thumbwheel readable 30° off-axis.
- Legend switch legend is legible.
- Precision of control manipulation is consistent with that of system.
- Selected, distributed so none of user's limbs are overburdened.
- Coding uniform throughout system.
- Useable in time required despite inadvertent operation protection.
- Movement oriented to operator if several stations are used.
- Control motion minimized; not cycled thru ON/OFF unnecessarily.
- Minimum use mode of horizontal or 3-position toggle switches.
- Shape coding free of sharp edges.
- Critical controls are not susceptible to accidental movement.
- Controls that initiate hazardous operations require prior operation of a locking control.
- Main power ON-OFF switch cuts all power to equipment.
- Emergency controls located near related warning display/instrument panel.
- Data manipulated without concern for internal storage.
- Control color related to display.
- Operating instructions provided except where use is obvious.
- Diagrams used where possible.
- Main power switch labeled.
- Emergency (noncritical) functional groups outlined with 3/16" red (1/16" black) border.
- Controls labeled as to function.
- Emergency entries are easily corrected.
- Internal software checks minimize user errors.

- Shape coded controls visually, tactually identifiable.
- Color contrasts with background.
- Ambient light color determines useable control color.
- Reference line has 50% min contrast with control color.
- Pointer parallax error between reference marks: 25% min.
- Thumbwheel internally lighted if ambient illumination below 1 ft-C.
- Thumbwheel readable 30° off-axis.
- Legend switch legend is legible.
- Precision of control manipulation is consistent with that of system.
- Selected, distributed so none of user's limbs are overburdened.
- Coding uniform throughout system.
- Useable in time required despite inadvertent operation protection.
- Movement oriented to operator if several stations are used.
- Control motion minimized; not cycled thru ON/OFF unnecessarily.
- Minimum use mode of horizontal or 3-position toggle switches.
- Shape coding free of sharp edges.
- Critical controls are not susceptible to accidental movement.
- Controls that initiate hazardous operations require prior operation of a locking control.
- Main power ON-OFF switch cuts all power to equipment.
- Emergency controls located near related warning display/instrument panel.
- Data manipulated without concern for internal storage.
- Control color related to display.
- Operating instructions provided except where use is obvious.
- Diagrams used where possible.
- Main power switch labeled.
- Emergency (noncritical) functional groups outlined with 3/16" red (1/16" black) border.
- Controls labeled as to function.
- Emergency entries are easily corrected.
- Internal software checks minimize user errors.

- Keyboard arrangement, number of keys compatible with info to be entered.
- Keel rest provided for pedal angle over 100°.
- Pedals reached easily.
- Keypads conform to MIL-STD-1290.
- Fixed function keys used for critical or frequent inputs.

- Isometric joystick: shaft length = 4.3"-7.1"; grip diameter = 2".
- Isometric joystick: hand-grasped for integral switching; otherwise finger-grasped.
- Only 1 switch per foot (preferred).
- Foot & stylus: required grips, display same size, mounted/oriented below display; preserve directional correlation.
- Display interface controllers size, shape: FIG 6.B.19-21.
- Rotary size, shape: FIG 6.B.1-6.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs.
- Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.
- Controller/follower movement ratio, displacement proportional.
- Conventional control movements:  $\geq 6$  ft-C.

- Isometric joystick: shaft length = 4.3"-7.1"; grip diameter = 2".
- Isometric joystick: hand-grasped for integral switching; otherwise finger-grasped.
- Only 1 switch per foot (preferred).
- Foot & stylus: required grips, display same size, mounted/oriented below display; preserve directional correlation.
- Display interface controllers size, shape: FIG 6.B.19-21.
- Rotary size, shape: FIG 6.B.1-6.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs.
- Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.
- Controller/follower movement ratio, displacement proportional.
- Conventional control movements:  $\geq 6$  ft-C.

- Isometric joystick: shaft length = 4.3"-7.1"; grip diameter = 2".
- Isometric joystick: hand-grasped for integral switching; otherwise finger-grasped.
- Only 1 switch per foot (preferred).
- Foot & stylus: required grips, display same size, mounted/oriented below display; preserve directional correlation.
- Display interface controllers size, shape: FIG 6.B.19-21.
- Rotary size, shape: FIG 6.B.1-6.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs.
- Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.
- Controller/follower movement ratio, displacement proportional.
- Conventional control movements:  $\geq 6$  ft-C.

- Isometric joystick: shaft length = 4.3"-7.1"; grip diameter = 2".
- Isometric joystick: hand-grasped for integral switching; otherwise finger-grasped.
- Only 1 switch per foot (preferred).
- Foot & stylus: required grips, display same size, mounted/oriented below display; preserve directional correlation.
- Display interface controllers size, shape: FIG 6.B.19-21.
- Rotary size, shape: FIG 6.B.1-6.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs.
- Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.
- Controller/follower movement ratio, displacement proportional.
- Conventional control movements:  $\geq 6$  ft-C.

- Isometric joystick: shaft length = 4.3"-7.1"; grip diameter = 2".
- Isometric joystick: hand-grasped for integral switching; otherwise finger-grasped.
- Only 1 switch per foot (preferred).
- Foot & stylus: required grips, display same size, mounted/oriented below display; preserve directional correlation.
- Display interface controllers size, shape: FIG 6.B.19-21.
- Rotary size, shape: FIG 6.B.1-6.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs.
- Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.
- Controller/follower movement ratio, displacement proportional.
- Conventional control movements:  $\geq 6$  ft-C.

- Isometric joystick: shaft length = 4.3"-7.1"; grip diameter = 2".
- Isometric joystick: hand-grasped for integral switching; otherwise finger-grasped.
- Only 1 switch per foot (preferred).
- Foot & stylus: required grips, display same size, mounted/oriented below display; preserve directional correlation.
- Display interface controllers size, shape: FIG 6.B.19-21.
- Rotary size, shape: FIG 6.B.1-6.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs.
- Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.
- Controller/follower movement ratio, displacement proportional.
- Conventional control movements:  $\geq 6$  ft-C.

- Isometric joystick: shaft length = 4.3"-7.1"; grip diameter = 2".
- Isometric joystick: hand-grasped for integral switching; otherwise finger-grasped.
- Only 1 switch per foot (preferred).
- Foot & stylus: required grips, display same size, mounted/oriented below display; preserve directional correlation.
- Display interface controllers size, shape: FIG 6.B.19-21.
- Rotary size, shape: FIG 6.B.1-6.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs.
- Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.
- Controller/follower movement ratio, displacement proportional.
- Conventional control movements:  $\geq 6$  ft-C.

- Isometric joystick: shaft length = 4.3"-7.1"; grip diameter = 2".
- Isometric joystick: hand-grasped for integral switching; otherwise finger-grasped.
- Only 1 switch per foot (preferred).
- Foot & stylus: required grips, display same size, mounted/oriented below display; preserve directional correlation.
- Display interface controllers size, shape: FIG 6.B.19-21.
- Rotary size, shape: FIG 6.B.1-6.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs.
- Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.
- Controller/follower movement ratio, displacement proportional.
- Conventional control movements:  $\geq 6$  ft-C.

- Isometric joystick: shaft length = 4.3"-7.1"; grip diameter = 2".
- Isometric joystick: hand-grasped for integral switching; otherwise finger-grasped.
- Only 1 switch per foot (preferred).
- Foot & stylus: required grips, display same size, mounted/oriented below display; preserve directional correlation.
- Display interface controllers size, shape: FIG 6.B.19-21.
- Rotary size, shape: FIG 6.B.1-6.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs.
- Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.
- Controller/follower movement ratio, displacement proportional.
- Conventional control movements:  $\geq 6$  ft-C.

- Isometric joystick: shaft length = 4.3"-7.1"; grip diameter = 2".
- Isometric joystick: hand-grasped for integral switching; otherwise finger-grasped.
- Only 1 switch per foot (preferred).
- Foot & stylus: required grips, display same size, mounted/oriented below display; preserve directional correlation.
- Display interface controllers size, shape: FIG 6.B.19-21.
- Rotary size, shape: FIG 6.B.1-6.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs.
- Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.
- Controller/follower movement ratio, displacement proportional.
- Conventional control movements:  $\geq 6$  ft-C.

- Isometric joystick: shaft length = 4.3"-7.1"; grip diameter = 2".
- Isometric joystick: hand-grasped for integral switching; otherwise finger-grasped.
- Only 1 switch per foot (preferred).
- Foot & stylus: required grips, display same size, mounted/oriented below display; preserve directional correlation.
- Display interface controllers size, shape: FIG 6.B.19-21.
- Rotary size, shape: FIG 6.B.1-6.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs.
- Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.
- Controller/follower movement ratio, displacement proportional.
- Conventional control movements:  $\geq 6$  ft-C.

- Isometric joystick: shaft length = 4.3"-7.1"; grip diameter = 2".
- Isometric joystick: hand-grasped for integral switching; otherwise finger-grasped.
- Only 1 switch per foot (preferred).
- Foot & stylus: required grips, display same size, mounted/oriented below display; preserve directional correlation.
- Display interface controllers size, shape: FIG 6.B.19-21.
- Rotary size, shape: FIG 6.B.1-6.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs.
- Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.
- Controller/follower movement ratio, displacement proportional.
- Conventional control movements:  $\geq 6$  ft-C.

- Isometric joystick: shaft length = 4.3"-7.1"; grip diameter = 2".
- Isometric joystick: hand-grasped for integral switching; otherwise finger-grasped.
- Only 1 switch per foot (preferred).
- Foot & stylus: required grips, display same size, mounted/oriented below display; preserve directional correlation.
- Display interface controllers size, shape: FIG 6.B.19-21.
- Rotary size, shape: FIG 6.B.1-6.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs.
- Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.
- Controller/follower movement ratio, displacement proportional.
- Conventional control movements:  $\geq 6$  ft-C.

- Isometric joystick: shaft length = 4.3"-7.1"; grip diameter = 2".
- Isometric joystick: hand-grasped for integral switching; otherwise finger-grasped.
- Only 1 switch per foot (preferred).
- Foot & stylus: required grips, display same size, mounted/oriented below display; preserve directional correlation.
- Display interface controllers size, shape: FIG 6.B.19-21.
- Rotary size, shape: FIG 6.B.1-6.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs.
- Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.
- Controller/follower movement ratio, displacement proportional.
- Conventional control movements:  $\geq 6$  ft-C.

- Isometric joystick: shaft length = 4.3"-7.1"; grip diameter = 2".
- Isometric joystick: hand-grasped for integral switching; otherwise finger-grasped.
- Only 1 switch per foot (preferred).
- Foot & stylus: required grips, display same size, mounted/oriented below display; preserve directional correlation.
- Display interface controllers size, shape: FIG 6.B.19-21.
- Rotary size, shape: FIG 6.B.1-6.
- Avoid the requirement of constant force on joystick.
- Isometric joystick: max. force for full output not to exceed 26.7 lbs.
- Direct relationship between stylus movement on grid and follower on display; follower remains stationary until stylus moved.
- Controller/follower movement ratio, displacement proportional.
- Conventional control movements:  $\geq 6$  ft-C.



## 8 DISPLAYS

Components that provide visual and auditory information to the operator concerning the status of operation. Provide positive indication of developing or current malfunctions. Displays are associated only with the item under test, not with equipment placed in or on it.

- Display relationship to control is apparent; determines control used, equipment displayed.
- Recurring groups, items have similar panel to panel location.
- Displays, groups have left-to-right and/or top-to-bottom order of use.
- Displays located so they can be read to the required degree of accuracy.
- Display positions correspond to positions of equipment monitored.
- Lighted control indicators are unambiguously associated with controls.
- Display viewing distances: 13-28".
- Pointer extends to but does not obscure or enclose index mark width.
- Pointers are close to dial to eliminate parallax, shadows.
- Conveyers, flags, printers, plotters: FIG 8.B.1.
- CRT target visual angle exceeds 2.0 minutes, 10 lines of resolution distance 16" (10" min).
- Large screen optically displays FIG 8.E.A.

• Design Requirements (MIL-STD-1472)  
• User-Computer Interface Data (MIL-STD-1472C)  
• Guidance Data (MIL-HDBK-759, Etc.)

- Display face to line of sight exceeds 45° min parallax, reflector.
- Frequently used displays are placed in optimal visual zones FIG 8.E.1.
- Illumination uniform FIG 8.E.1.
- Indicator lights show responses, used sparingly, visible.
- Contrast, luminance exceeds 50%.
- Flashing lights: 3-5 flashes/sec.
- CRT headed if ambient over 5 ft-C.
- Printed, plotted output visible.
- Projection displays FIG 8.E.2.
- Illumination balanced full on in all.
- Display precision, response is constant with that of system.
- Information displayed: Clear, specific, precise, readable; not redundant, degraded by vibration; timely.
- Scales: linear, short of 0, use whole numbers, 2 pointers max, numerals oriented upright.
- Audio signal evolutions FIG 8.F.3.
- Audio, verbal warnings 20 dB min above background.
- Material in printers, plotters easily changed; supplies indicated.
- Failure immediately apparent.
- Signal absence does not mean "out".
- Indicator light color coding for emergency, warning, summation, etc: FIG 8.F.1; master lights set apart.
- Audio warnings transmitted to both earphones and work area.
- Audio signal action segment specifies nature of problem.
- Prohibited, persistent signals are not used FIG 8.G.1.
- Audio warning duration min of 5 sec until corrective action taken. Minimum decoding required.
- Trademarks, irrelevant information, etc do not appear on panel face.
- Coding techniques uniform facilitate discrimination, identification, relationship, criticality.
- Auditory displays used where vision overburdened, degraded redundancy desirable; warning, cue needed.
- Verbal warnings intelligible, apt.
- Audio warnings use standard signals.
- Labels: functionally basic; well located; graduated in size.

- Display pointer tip same color as marks.
- Flashing lights synchronized.
- In form fillings user doesn't remove unused underscores; cursor machine positioned and tab bar advanced; missing data indicated; protected areas designated.
- Text conforms to MIL-STD-490; paragraphs separated by min. of 1 blank line.
- Feedback for correct control input consists of changes of state or value for controlled elements.
- Display changes represent functional state.
- Transilluminated indicators display system status, immediate action, adjustment functions.
- Software minimizes operator task complexity.
- Novelty minimization minimized.
- Inventory indicators acceptance and unavailability of input and delay.
- Data entered via keyboard are displayed, as keyed, on the screen.
- Auditory displays have test device.
- Operator and maintainer information not combined unless compatible for both uses.
- Spelling and common errors don't produce valid commands.
- Multiple level systems have minimum levels, priority access to critical levels, indicate current position.
- Auditory displays volume adjustable.
- Projection displays avoid "keyhole" effects.
- Display freeze made provided; has mode feedback.
- Information grouped to permit association of like classes.
- Data presented in readily usable and readable format.
- Internally detected error messages explicit, neutral in tone.
- Need for entry of already available information minimized.

- Large screen displays: visual access to critical operators prevents inadvertent deletion of info; assigned to command; person; separate display for individual change/received info.
- Location and presence of control input data clearly indicated.
- Recurring tabular data is similarly located.
- All data needed to support activity is grouped together.
- Digital values requiring reliable reading updated 1 per second or less.
- Cross or rate of change values updated between 2 and 5 per second.
- Graphic displays requiring integration of rapidly changing patterns updated consistent with the user's information handling rate.
- Feedback for correct control input consists of changes of state or value for controlled elements.
- Priority information obvious.
- Large screen user group viewing space constraints; mobile operators.
- Inserted items are collected in buffer, displayed in insert area, and inserted simultaneously.
- Mechanical overlays for keyboards, displays are avoided.
- Displays are designed for the expected operational environment.
- Expected use of information determines update rates.
- Hard copies of displays are obtainable.
- Prompts and structuring features available for interactive sessions and error location.
- Nomenclature approved by procedure agency.
- Abbreviations from MIL-STD-17, MIL-STD-411, and MIL-STD-781.
- Feedback provided to articulate system status.
- Command language reflects user's point of view.
- Program allows for orderly shutdown and establishment of checkpoints.

## 10 WORKSPACE

The area within which the user operates the equipment. Includes space for controls, displays, optics, electronic devices, weapons and windows as well as standing areas, consoles and seats. Provides storage for excess clothing, personal gear, weapons and tools. Protects operator from adverse environment, when applicable.

- Display placement above standard (seated) surface: normal, 41-70" (64" precisely, frequently read, 51-65" (14-35"), 21" from centerline.
- Controls on vertical surface above floor (seated normal, 34-70" (48-53" precisely, frequently used, 34-53" (18-29"), 21" from user centerline).
- With vision over console top critical warning display 22" min above seat.
- Work surface height: standing, 34-48" seated, 28-31".
- User oriented to work site.
- Seats fit suitably clothed 5-95th user without degrading performance.
- Arm rests 24" min.
- Back, seat have 1" min padding.
- If van occupancy exceeds 1 ceiling height 78" min.
- Lateral work (writing) space 30 in (24 in) min.
- Standard console FIG 10.B.1-3.
- Cases (lateral) dimensions: seated 19 1/2" (5th %), fully equipped 24 1/2" (95th %), 25 1/2" (95th %), 26 1/2" (95th %).
- Adjustable dimensions for 5-95th %.
- Vertical seat adjustments 15-27" in 1 min increments.
- Seat backrest reclines 103-115°; supports torso as operator's eyes are within 3" of "eye-line".
- If arms adjust: 78-11" above seat.
- Seat adjusts fore, aft: 6" min.
- Operator does not have to lift seat to adjust seat.

- Cabinet kick space 44" had min.
- Console front floor space: 4 min.
- Knee room 23 1/2" (8" had min).
- Work space: 24 in (24 in) min.
- Allowances made for heavy clothing, protective equipment.
- Seat adjustment overhead clearance from seat pans 40" min.
- Sufficient clearance for use with gloves, arctic mitts, heavy clothing.
- User space not encroached upon by others.
- Reflection of instruments, consoles in windows, windshields avoided.
- Right-left viewing angle for wrap-around console: 135° min.
- Illuminations: FIG 10.1.1.
- Surface colors conform to MIL-STD-1473.
- Reflectances: FIG 10.1.3.

- Seating compatible with consoles.
- Heating, A/C for multiple (permanent) duty work areas: 50° F (65° F) in 85° F; does not discharge on crew.
- Ventilation: 30 cu ft/min/man max; velocity 100 ft/min max.
- Effective temperature: FIG 10.F.1.
- Acoustical environment does not degrade system effectiveness.
- Noise levels: FIG 10.F.2-8.
- Room sound absorption coeff: 0.20 min.
- Whole body vibration limits: X, Y, Z times FIG 10.F.9.
- Exposure to gases, fumes, toxicity are THRESHOLD LIMIT VALUES.
- Impulse noises: FIG 10.G.1.
- Noise duration limits: FIG 10.G.3.
- Hazard starting device provided.
- Illumination adequate.
- Equipment guarded if temp exceeds 160° F (120° F if handled).
- Exposed edges (corners) rounded: 0.04" (0.5") min radius.
- Guards provided on moving parts.
- Arctic clothing men not exposed to temp above 60° F; 35-65° F optimal.
- Adequate, suitable storage for manuals, worksheets, etc.
- Stands have work surfaces to support manuals, etc.
- Conspicuous placards adjacent to equipment hazardous to use.
- Areas requiring special equipment, clothing are specifically identified.
- Emergency procedures detailed.
- Instructions kept simple.
- Manuals, markings include warnings on toxic, thermal hazards of heaters, exhaust gas.



## 10 WORKSPACE

**अनुपम**

- Provides storage for excess clothing, personal gear, weapons and tools.
- Protects operator from adverse environment, when available.

y; value not  
 s; prevents a  
 info; assigned to  
 separate entity  
 allocated for  
 one of control  
 dicated.  
 kula is secondary  
 support activity

- Display placement: Above standing line of vision, not more than normal, 41-70° (4-44°); precisely, frequently read, 50-55° (14-33°); 21° from centerline.
- Controls on vertical surface above floor (except normal, 34-70° (8-34°)); precisely, frequently used, 34-53° (8-29°); 2° from user centerline.
- With vision over console top: critical warning display 28° from above seat.
- Warning lights: standing, 36° ± 5° seated, 29-31°.
- User oriented to work site.
- Seats fit suitably clothed 5-95th% user without degrading performance.
- Arm rests 248° min.
- Back, not less than 17 mm padding.
- If arm occupancy exceeds 1 hr:
  - Lateral work (working) space: 30x16" (24x16") reach min.
  - Standard complete EFR, 10.8L1-3.
  - For use with seat, all dimensions based on 50th % EFR, 10.1L1-3. The equipment must be 25.24L1-3. An EFR, 10.1L1-3.
- Adjustable dimensions fit 5-95th%.
- Vertical seat adjustments 15-21" in 1" max increments.
- Seat backrest reclines 103-115°; supports torso so operator's eyes are within 10° of horizon.
- If arms adjust 78-111° above seat.
- Seat adjusts fore, aft: 48".
- Operator does not have to lift to adjust seat.

- Cabinet links spaces 48" max.
- Console front floor spaces min.
- Knee area 25x20x18" head min.
- A:  $\frac{1}{2}$  inch  $\frac{1}{2}$  inch  $\frac{1}{2}$  inch  $\frac{1}{2}$  inch  $\frac{1}{2}$  inch  $\frac{1}{2}$  inch
- Allowances made for heavy clothing, protective equipment.
- Seat adjustment overhead clearance from seat pan 40" min.
- Sufficient clearance for use with gloves, arctic mitts, heavy clothing.
- 18" of space not encroached upon by others.
- Reflection of instruments, controls in windows, windshields avoided.
- Right-left view any angle for wrap-around consoles 190° max.
- Illumination: FIG. 10.2.1.
- Reflectance colors conform to MIL-STD-1473.
- Reflectance: FIG. 10.2.3.

- requiring reliable per second or change values and 5 per second.
- requiring integrating patterns with the user's rate.
- of control input of state & value mts.

obvious.  
group viewing;  
mobile operations,  
e collected in  
insert area, and  
rsly.  
s for keyboards,  
igned for the  
environment.  
ormation deter-  
lays are obtain-

turing features  
 active sessions  
 ived by procur-  
 r. MH-STD-12,  
 HL-STD-183,  
 ) to indicate  
 reflects user's  
 orderly shut-  
 ment of check-

## 11 COMMUNICATIONS

Devices and techniques for communicating information among crewmen within the workspace, between the crew and externally located individuals, and between the crew and remotely located persons.  
Includes antennas, where applicable.

- Loudspeakers used to monitor several channels are mounted at least 10' apart radially to operator.
- Microphones, headphones, headset permit hands-free operation.
- When several handsets are used, the most frequently, urgently needed is the most accessible.
- Accessible volume, gain controls are provided for each channel.
- Fast operated "Send-Receive" control when both hands busy.
- Earphones, headsets easily adjusted, accommodate 5th-95th % users: FIC, 25.8.4.

- Earphones, headsets easily adjusted, accommodates 5th-95th% users: FIC, 25.8.4

- Reach to communication controls is unobstructed.
  - Workspace accommodates operators wearing earphones, headset.
  - Radio antenna located to minimize radio-frequency hazards.
  - Operations possible wearing arctic mittens, arctic headwear.
- Color coding used when multiple handsets are visible, available to nonoperator.

- Microphone, headset, single (rudimentary) speaker; 100-120 dB (100-1400 Hz); dynamic range 50 dB; in 100 dB area; 100 dB rms max.  
Microphone: noise cancelling in 100 dB area; 100 dB rms max.  
Filtering, clipping is used to improve intelligibility.  
Ambient noise exceeds 85 dBA(A).  
Volume, gain: audible range 110 dB max; squelched.  
Volume/power control has detent between min volume, off.  
Communication equipment works by operation of a microphone and metal parts do not contact user's skin.  
Headsets worn in high ambient noise provide attenuation equal to ear protective devices.  
Warning signal intensifies "less than good discomfort," "inping" in the ears.  
Exposed metal parts grounded.  
System allows emergency messages top priority, does not interfere with their transmission, reception.  
Speaker hears own voice in his headset in phase with his speech.  
Visual display of intelligibility criteria: FIG. 11.H.1.  
Audio signals coded as to maintenance, emergency, health hazard, etc to minimize operator's visual display search.  
Instructions provided for use and fault detection for communications equipment.

## 12 FASTENERS, CONNECTORS

latches, fasteners and connector alignment and locking devices such as lock pins, safety wires, pins, nuts, electrical plugs, and fittings.

- It is impossible to insert a wrong plug into a receptacle.
- Plugs, receptacles have clamping pins for insertion.
- Aligning pin extends beyond plug electrical pins.
- Plug receptacles arranged so aligning pins are oriented in the same relative position.
- Connectors placed so that springs do not cause damage.
- Springs, corner operating parts are easily accessible.
- Identical screws, built heads precluded throughout; one removal tool.
- Fastener heads large enough to be grasped, handled.
- Non-interchangeable connectors for different uses.
- Coffer keys snug fit, large head.
- Size, shape coded pins avoid mis-matches (Fig 13.11).
- Connectors are electrically different when keys have different lengths.

- Bolts requiring high torque have an external griphhead.
- Fasteners, plugs require one turn in to tighten, loosen.
- Over 10 ft.-lb. torque use external griphheads; below 10 ft. lb. use internal, external or combo griphheads.
- ~~Loose~~ disconnect, snap action, release, twist; up to one full turn for frequent, critical use.
- Tighten CCW; loosen CCW.

- \* Grasp (lifting) dimensions based on 95th percentile operator's hand, arm, FR, 25.51-35.5.
- \* Adequate space available to grasp connectors firmly.
- \* Adequate space to use connector lever.
- \* Grips are to be use are removable.
- \* Connectors are separated by 0.75" (1.25") if used with bare (gloved) fingers.
- \* Mounting screws have clearance holes.
- \* Connectors visible, accessible.
- \* Labels, codes visible in connected, unconnected state.
- \* Easy visual access is provided for storing threads, pins.
- \* 12 inch readily clear distance from each other under real operational lighting.

- Number, type, minimum commensuration with strain, bending radius.
- Captive fasteners used wherever drop-down wire crassers hazards covers need frequent removal.
- Balls have min number of turns.
- Only standard tools are used.
- Adapters for pin connectors can be hand tightened.
- Fasteners used outside are operable under all environmental conditions.
- Connectors are compatible with cables, lines, fasteners, mounting.
- Removal of plug, connector does not expose hot leads.
- Plug of one voltage rating cannot be inserted into the receptacle of another voltage rating.
- All hot contacts are sockets.
- Interlocking devices only use when critical mechanical function, personnel safety.
- Use captive type dust covers where necessary.
- Capt, inserts, covers, cases, shields provided where necessary.
- Receptacles marked as to voltage, phase, frequency.
- Connectors, receptacles identified by color, size.
- Plugs, receptacles have stripes, arrows, etc to show aligning pin positions.
- Manner of connection obvious.
- Non-standard operating direction is clearly marked.
- Plug, receptacle identifications FIG. 13.3.

## 15 0/10

Components that use the human eye for sighting, aiming or viewing.  
includes eyepieces, reticles, filters, sighting mechanisms, range finders, viewers.

- Optical instruments are mounted in goggle operator a comfortable angle of view.
  - Purging, charging fittings are accessible for maintenance.
  - Components requiring frequent maintenance, special tools are not required.
  - Inter-pupillary distance between eyepieces adjustable, 50-76 mm.
  - Eyecups prevent stray light from entering eyes.
- 
- Gross (limiting) dimensions based on 95th % (5th % for FFG 25JSL).
  - Field of view is compatible with use, optical-mechanical limits.
  - Entrance pupil : magnification = exit pupil dimensions.
  - Reticle lines: thin enough not to block target; thick enough to be seen.
  - Eyepiece specifications FFG 15JSL.

- 7 synapses used during low light level viewing that exceeds 1 minute.
- Eyes don't have to adjust beyond normal functional ability.
- Magnification difference between the two eyes: 2% max.
- Difference in amount of light between the two eyes: 5% max.

- Eye reticle is at least 15 mm.
- Eyecups, headstocks compatible with helmets, masks, etc.
- Line reticles preferred over those with 1, 2 or 3 central spots.
- Small cross or circle preferred over dot for reticle.
- Ring preferred over a spot for reticle.
- Optic components accommodation erect headwear, headwear.

- Reticles are illuminated for night, twilight operations.
- Illumination over blue color not used; dimming at dead level remains fixed under vibration.
- Level vials, scales, pointers are readily visible, illuminated for low light condition use.
- Lighting minimally affects the dark adaptance of observer.
- Luminous transmission exceeds 50% parallel incidence.

- Filters used for high light levels.
  - Adjustment of eyes beyond normal ability is not required.
  - Magnification is high enough for required application.
  - Resolutions: 60 sec of arc min.
  - Oracles or a matched pairs.
  - Instruments reading steady eye usage have brow pads.
  - Level visible, scales, pointers are protected from damage.
  - Focusing -4 to +2 diopters for over 6-power.
- Eyecups are made of soft rubber or equivalent material.
- No skin contact with metal parts.

- Components, parts are labeled.  
If periodic purging, charging is required an instruction plate indicating time interval, pressure is attached.

- 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26

**16** OREGONIAN LUMBER CO.

Components which control the operation of the dam.  
Includes triggers, fuses, cables, etc.  
Does not include controls as such, although there is some overlap.

- Controls used only for maintenance or adjustment are covered during normal operation but are accessible visible when required.
- Fast controls are not used for precise adjustments.
- Joysticks for tracking have hand rest support.

- Tracking crank size is a function of rotation speed: 200 rpm max.
- Tracking crank radius for high (low) rpm: 28" (48").
- Handshunts knurled or unknurled.

- Knobs preferred over screwdriver for frequent adjustment.
- Slight means leveling w/ supports strong enough to prevent bubble displacement.
- Feet pads: rise from a depressed position backwards & vertically.
- Power controller: backlock, 0, 4000 rpm;  $\pm 1^\circ$ ; operating torque, 5 lb.

- Compatible with hardware used.
- Self alignment devices provided for remote handled items.
- Printers have quick, easy insertion, removal of printing materials.
- Printers allow for generation of data in the printer.

- 10

- Tracking control movement is compatible with expected, conventional control movements.

- CG, weight of equipment marked, where applicable.  
Weight capacity indicated on all lifting equipment.  
Items exceeding one-man lift value, labeled as to weight, lift limitation.  
Critical warning label located near hazard.



TEST FUNCTION \_\_\_\_\_

TEST ITEM CLASS V \_\_\_\_\_

SUBCLASS A \_\_\_\_\_

OBJECTIVE: Evaluate the effectiveness and safety of the design of maintenance and repair equipment and systems to enable the user to prepare the item, prepare the work-site, and perform maintenance and repair. The HFE subtest should consider evaluation of user performance and safety for these functions under conditions representative of those expected in actual use of the item.

1.  
2.  
3.

| PREPARE ITEM   |   |                                  |
|--|---|----------------------------------|
| UNSTOW/CONFIGURE   | EMPLACE/POSITION AT WORKSITE  |                                  |
| PURPOSE: Evaluate the design of the test item and procedural guidance for ease of assembly and disassembly of item elements. | PURPOSE: Evaluate the design of the test item for moving and positioning at the worksite. | PURP<br>design<br>manic<br>nomic |
| MAN/ITEM TASKS   | MAN/ITEM TASKS  | MAN/                             |
| Identify parts.  | Move assembly.  | Take                             |
| Unstow parts.  | Position/orient components.   | Adju                             |
| Layout/display parts.  | Emplace at worksite.  | Set u                            |
| Align/adjust parts.  | Locate components at worksite.  | Prep                             |
| Make connections.  |   | Sele                             |
| Assemble parts.  |   | Part                             |
| Mate subassemblies.  |   | Reas                             |
| Prepare rig.   |   | Prep                             |
| Read instructions.   |   | Load                             |

| Test Item<br>Components<br>HUMAN FACTORS<br>CONSIDERATIONS | INDEX TO DET                         |                                  |                                 |                 |                               |                     |
|--|--------------------------------------|----------------------------------|---------------------------------|-----------------|-------------------------------|---------------------|
|  | Labels<br>Manuals<br>Markings<br>(1) | Lines<br>Hoses<br>Cables<br>(12) | Fasteners<br>Connectors<br>(13) | Handles<br>(14) | Operating<br>Elements<br>(15) | Lab<br>Mark<br>(16) |
| A. LOCATION & ARRANGEMENT                                  | A                                    | A                                | A                               | A               | A                             | A                   |
| B. SIZE & SHAPE  | B                                    | B                                | B                               | B               | B                             | B                   |
| C. DIRECTION & FORCE                                       | C                                    | C                                | C                               | C               | C                             | C                   |
| D. CLEARANCE   | D                                    | D                                | D                               | D               | D                             | D                   |
| E. VISIBILITY  | E                                    | E                                | E                               | E               | E                             | E                   |
| F. USE CONDITIONS  | F                                    | F                                | F                               | F               | F                             | F                   |
| G. SAFETY  | G                                    | G                                | G                               | G               | G                             | G                   |
| H. OPERATING PROCEDURES                                    | H                                    | H                                | H                               | H               | H                             | H                   |







## 1. GENERAL COMPONENTS

### 1.1. GENERAL COMPONENTS

**A. LOCATION & APPROPRIATE LABEL**  
The location of a component as it affects the ability of the operator to reach, operate or manipulate it, including location of controls, displays, switches, or other operating elements of components, knobs, levers, etc., as well as its relationship to other components.

**B. FUNCTION & OPERATION**  
The function and operation of a component, including its purpose, its use, its operation, its maintenance, and the shape and position of controls, knobs, levers, etc., as well as its relationship to other components.

**C. OPERATION & FORCE**  
The movement and/or force required to operate a component, including its operation, its use, its operation, its maintenance, and the shape and position of controls, knobs, levers, etc., as well as its relationship to other components.

**D. CHARACTERISTICS**  
The characteristics of a component, including its purpose, its use, its operation, its maintenance, and the shape and position of controls, knobs, levers, etc., as well as its relationship to other components.

**E. VISIBILITY**  
Those aspects of a component that contribute to the operator's ability to see it clearly, including location, size, shape, color, contrast, field of view, viewing distance, reflectance, and illumination.

**F. IDENTIFICATION**  
Those aspects of a component that pertain to its operational status before, during and after use, as well as the importance of an acceptable identification in the workspace area.

**G. SAFETY**  
Those aspects of a component that could cause injury to the operator or other personnel, including prevention of injury, visibility, or other safety-related factors, including location, size, shape, color, contrast, field of view, viewing distance, reflectance, and illumination.

**H. IDENTIFICATION & LABELS**  
Those operational and informational aspects of a component that pertain to its operational status before, during and after use, as well as the importance of an acceptable identification in the workspace area.

## 2. LABELS, MARKINGS, MARKINGS

Provide technical guidance in the form of written material, schematics, diagrams, illustrations and instruction plates.  
Make operator aware of hazards.  
Give special guidance or instructions.

Controls, displays, etc. are clearly, appropriately labeled except where use is obvious.  
Labels placed on or near items they identify.  
Do not cover other information.  
Label is not behind control.  
Label location consistent.  
ID labels not obscured by components on flat surfaces on main chassis; min coverage by grime; not easily removed.

Character height determined by distance read; luminance: FIG 1.B.1.  
Group label characters larger than those of controls, displays which are larger than control, display position characters: each by 25% min.  
Letter, numeral styles: FIG 1.B.2-4.  
Height/width ratio: 5:3; "M" & "W" are 1 stroke width wider; "M" & "W" are 1 stroke width.  
Stroke width for black (white) characters on light (black) background: 1/6 (1/7-1/8) of height.

Spacing between characters (word): one stroke (character) width min.  
Line spacing: 1/2 character height.  
Counter numeral low ratio: 1:1 (except 1:2 separation: 1/2 to 1/3 w).  
Optical projection: all caps, stroke width 1/6 to 1/8 h; exceeds 15 minutes visual angle.  
Thumbwheel numeral low ratio: 1:2; h: 1/2 stroke width internally (externally) illuminated: 10:1 (5:1).  
Abbreviations all caps, no periods.  
Stretched copy uses lower case.  
Label characteristics determined by illumination levels, color.  
Labels easily, accurately read at operational viewing distance, vibration, light levels, environments.  
Labels are sharp with high or color contrast.  
With illumination above 1 ft-cd black letters, light background.  
Dark adaptation letters visible, do not interfere with night vision.  
Chart reading: FIG 1.B.1.1.

Label characteristics accuracy required: time available distance (light level, color) criticality of function consistency of design.  
Labels on production equipment are as durable as the equipment.  
Labels for prototype equipment easily affixed, altered, removed.  
Labels not covered by other units nor obscured by grime, dirt.  
Markings, tags are as permanent, washable as equipment.  
Roman numerals avoided.  
Vertical labels used only when labels are not critical for personnel safety, performance.  
Warning placards illuminated.  
Warning notices clear, direct characters 25% larger than any following instructions.  
Placards adjacent to hazards.

Abbreviations are standard (MIL-STD-121), new OK if obvious.  
Code names, irrelevant info do not appear on labeling.  
Labels concise; min redundancy.  
Abstract symbol only if meaningful.  
Words familiar to user.  
Hand group areas identified.  
Areas of graphs labeled and graduated appropriately.

## 3. DISPLAYS

Components that provide visual and auditory information to the operator concerning the status of operation.  
Provide positive indication of developing or current malfunctions.  
Displays are associated only with the item under test, not with equipment placed in or on it.

Display relationship to control is apparent; determines control used, equipment displayed.  
Functionally related units grouped.  
Displays, groups have left-to-right and/or top-to-bottom order of use.  
Displays located so they can be read to the required degree of accuracy.  
Lighted control indicators are unambiguously associated with controls.  
Emergency, critical, important displays located in 30° cone about line of sight.  
Display viewing distance: 13-28".  
Pointer extends to but does not obscure or exceed index mark width.  
Pointers are close to dial to eliminate parallax, shadows.  
Counters, flags, printers, plotters: FIG 8.B.1.  
CRT target visual angle exceeds 2.0 minutes, 10 lines of resolution distance 16" (10" min).

Display face to line of sight exceeds 45° min parallax, reflections.  
Frequently used displays grouped in optimal visual zone: FIG 8.E.1.  
Illumination uniform: FIG 8.E.3.  
Indicator lights show response, used sparingly, visible.  
Contrast, luminance exceeds 50%.  
Flashing lights: 3-5 flashes/sec.  
Color coding used where possible; unused scales covered.  
Display pointer tip same color as marks.

Display precision, response is consistent with that of system.  
Information displayed: Clear, specific, precise, unambiguous; not redundant, degraded by vibrations timely.  
Lights show functions: FIG 8.F.1.  
Scalers, timers, start at 0, use whole numbers, 2 pointers max, numerals oriented upright.  
Mechanical types: FIG 8.F.2.  
Audio signal evaluation: FIG 8.F.3.  
Audio, verbal warnings: 20 db min above background.  
Failure is immediately apparent.  
Signal observer does not mean "go".  
Indicator light color coding for emergency, warning, summation, etc: FIG 8.F.1; master lights set apart.  
Audio warnings transmitted to both earphones and work area.  
Audio signal action segment specifies nature of problem.  
Prohibited, persistent signals are not used: FIG 8.G.1.  
Audio warning duration min of 5 sec; until corrective action taken.  
Minimum decoding required.  
Trademarks, irrelevant information etc do not appear on panel face.  
Coding techniques uniform; facilitate discrimination, identification, relationship, criticality.  
Auditory displays used when vision overburdened, degraded redundancy desirable; warnings, cue needed.  
Verbal warnings intelligible, not.  
Audio warnings use standard signals.  
Labels: functional; basic; well located; graduated in size.

Display pointers are aligned for common stable values.

Stacked, alternately presented legends visible.  
Illumination balanced full on to off.

Display changes represent functional state.  
Transilluminated other displays: FIG 8.F.4-5.  
Transilluminated indicators display system status, immediate action, etc: FIG 8.F.6.  
Circular dials: FIG 8.B.2.  
Upper and lower information information not combined unless compatible: FIG 8.F.7.  
Priority information obvious.

Audio and video displays have test device.  
Audio and video displays volume adjustable.  
Priority information obvious.

## 4. WORKSPACE

The area within which the user operates the equipment.  
Includes space for controls, displays, optics, electronic devices, weapons and windows as well as standing area, consoles and seats.  
Provides storage for excess clothing, personal gear, weapons and tools.  
Protects operator from adverse environment, when applicable.

Display placement above standing (seated) surfaces: normal, 61-70" (66-68" precisely, frequently read, 50-65" (14-15" ± 21" from centerline).  
Controls on vertical surface above floor (seated) normal, 34-70" (34-34" precisely, frequently used, 34-53" (8-29" ± 21" from very centerline).  
Work surface height standing, 36 ± 6" seated, 29-31".  
User oriented to work site.

Seats fit suitably clothed 5-95th % user without degrading performance.  
Arm rests 2-8" min.  
Back, seat have 1" min padding.  
If use occupancy exceeds 1 hr ceiling height 78" min.  
Lateral work (writing) space: 30x16" (24x16") and min.  
Standard consoles: FIG 10.B.1-3.  
Cross (limiting) dimensions based on 95th (5th) user: FIG 25.B.1-2.  
Adjustable dimensions fit 5-95th %.

Workspace anthropometrics: FIG 10.D.1-2.  
Cabinet kick space 4x4" had min.  
Console front floor space 4" min.  
Knee room 25x20x18" had min.  
Allowances made for heavy clothing, protective equipment.  
Seat adjustment overhead clearance from seat pan 40" min.  
Sufficient clearance for use with gloves, arctic mitts, heavy clothing.  
User space not encroached upon by others.

Right-left viewing angle for wrap-around consoles: 120° max.  
Illumination: FIG 10.E.1.  
Surface colors conform to MIL-STD-1473.  
Reflectance: FIG 10.E.3.

Seating compatible with consoles.  
Heating, A/C for mobile (seated) dwell work areas 50° F (65° F) to 85° F, does not discharge on crew.  
Ventilation 30 cu ft/min/man min velocity 100 fpm max.  
Effective temperature: FIG 10.F.1.  
Acoustical environment does not degrade system effectiveness.  
Noise levels: FIG 10.F.2-8.  
Whole body vibration limits X, Y, Z, time: FIG 10.F.9.

Exposure to gases, fumes, toxicity and THERMAL LIMIT VALUES.  
Impulse noise: FIG 10.G.1.  
Noise duration limits: FIG 10.G.3.  
Illumination adequate.  
Equipment guarded if temp exceeds 160° F (100° F if handled).  
Exposed edges (external) rounded 0.06" (0.07" min radius).  
Guards provided on moving parts.

Adequate, suitable storage for manuals, worksheets, etc.  
Stencils have work surfaces to support manuals, etc.  
Conspicuous placards adjacent to equipment hazardous to user.  
Areas requiring special equipment, clothing are specifically identified.  
Emergency procedures detailed.  
Instructions kept simple.  
Manuals, markings include warnings on toxic, thermal hazards of heaters, exhaust gas.

## 5. ACCESSORIES

All of vests, e test ches. Plugs, tings for includ well as 8

Condu held b Long equip Test e panel i displa Reels, large, Cover 1 me, 1 rle in

Cable functi versen vied. Electr Cable simul

Hand used 9 Tighte

Adapt cables Clean trafe rle, rle in

Line, with h Mems is abel

Numbr mixed Cable Irregu sions e Cable kide, v ent, 1 Cable hacter Probe avail

Progr 1007 High chain Auton equip legs. Electr lines e

Multip Cable ment, Line e FIG 12 Dange Hydra



## DISPLAYS

Components that provide visual and auditory information to the operator concerning the status of operation. Provide positive indication of developing or current malfunctions. Displays are associated only with the item under test, not with equipment left on or off.

Display relationship to control is up-  
erly determines control used, e-  
ment displayed, relationally related units grouped.  
Displays, groups have left-to-right  
d/or top-to-bottom order of use.  
Displays located so they can be read  
the required degree of accuracy.  
Shifted control indicators are un-  
quously associated with a func-  
tion, warning, critical, important func-  
tion located in 80° cone of vision  
sight.  
Display viewing distance is 13-28".  
Inter-extends to but does not ob-  
scure or exceed index mark with in-  
teriors are close to dial to elimi-  
nate parallax, shadows.  
Numbers, flags, pointers, plotters:  
2.8.8.1.  
Target visual angle exceeds 2.0  
minutes, 10 lines of resolution dis-  
tance 14" (10° min).

Display face to line of sight exceeds  
1 min parallax, reflection.  
Display used displays grouped in  
normal visual zone: FIG 8.F.1.  
Illumination uniform: FIG 8.F.3  
Color lights show response, used  
ringly, visible.  
Contrast, luminance exceeds 50%.  
Jung lights: 3-5 flashes/sec.  
or coding used where possible;  
red scales covered.  
Display pointer tip same color as  
background.  
Display precision, response is charac-  
teristic with that of system.  
Information displayed: Clear, speci-  
fically, unambiguously not redundant,  
defined by vibration; timely  
its show functions: FIG 8.F.1.  
es: linear, start at 0, use whole  
bers, 2 pointers max, numerals  
used upright.  
Information types: FIG 8.F.2.  
a signal evaluation: FIG 8.F.3.  
a verbal warnings: 20 dB min  
background.  
are immediately apparent.  
at absence does not mean "go".  
color light color coding for  
gency, warning, summation, etc:  
8.F.1; master lights set apart.  
a warnings transmitted to both  
hones and work area.  
a signal action segment specifi-  
cation of problem.  
hibited, persistent signals are not:  
FIG 8.G.1.  
a warning duration min of 5  
until corrective action taken.  
num decoding required.  
examples, irrelevant information  
is not repeated on panel face.  
ing techniques uniform for dis-  
crimination, identification,  
analysis, criticality.  
color displays used when vision  
is deficient, degraded; redomance  
color warning, use needed.  
a warnings intelligible, opti-  
mal; functional; basic; well in-  
cluded in size.

\* Display pointers are aligned for  
common stable values.

\* Stacked, alternately presented  
legends visible.

\* Illumination balanced full on to off.

\* Display changes represent func-  
tion state.  
\* Transilluminated other displays:  
FIG 8.F.4-5.  
\* Transilluminated indicators display  
system status, immediate actions  
of system functions.  
\* Circular dials: FIG 8.B.2.  
\* Graphic and maintain information  
not combined unless compat-  
ible for both uses.  
\* Priority information obvious.

\* Auditory displays have test device.  
\* Auditory displays: volume adjust-  
able.  
\* Priority information obvious.

## 10 WORKSPACE

The area within which the user op-  
erates the equipment.  
Includes space for controls, displays,  
optics, electronic devices, weapons  
and windows as well as standing areas,  
consoles and seats.  
Provides storage for excess clothing,  
personal gear, weapons and tools.  
Protects operator from adverse en-  
vironment, when applicable.

\* Display placement above standing  
surface: normal, 41-70" (6-  
46°); precisely, frequently read, 50-  
65" (14-35°); 21° from centerline.  
\* Controls on vertical surface above  
floor (seath normal, 34-70" (8-34°);  
precisely, frequently used, 34-53"  
(8-29°); 21° from user centerline.  
\* Work surface height: standing, 34 ±  
1 1/2" seated, 29-31".  
\* User oriented to work site.

\* Seats fit suitably clothed 5-95th%  
user without degrading performance.  
\* Arm rests 240° min.  
\* Back seat height 1" min padding.  
\* If van occupancy exceeds 1 hrs  
ceiling height 78" min.  
\* Lateral work (writing) space 30x16"  
(24x16") wide min.  
\* Standard console FIG 10.B.1-3.  
\* Gross (limiting) dimensions based on  
95th% (5th%) user: FIG 25.B.1-7.  
\* Adjustable dimensions fit 5-95th%.

\* Vertical seat adjustment 15-21" in 1"  
max increments.  
\* Seat backrest reclines 103-115°, sup-  
ports torso so operator's eyes are  
within 3° of "eye-line".  
\* If arms adjust 78-111° above seat.  
\* Seat adjusts fore, aft 4" min.  
\* Operator does not have to lift self  
to adjust seat.

\* Workspace anthropometrics: FIG  
10.D.1-2.  
\* Cabinet kick space 4x4" hnd min.  
\* Console front floor space 4" min.  
\* Knee room 25x20x18" hnd min.  
\* Allowances made for heavy clothing,  
protective equipment.  
\* Seat adjustment overhead clearance  
from seat pans 40" min.  
\* Sufficient clearance for use with  
gloves, arctic mitts, heavy clothing.  
\* User space not encroached upon by  
others.

\* High-left viewing angle for wrap-  
around displays, 100° min.  
\* Illumination: FIG 10.E.1.  
\* Surface colors conform to MIL-STD-  
1473.  
\* Reflectance: FIG 10.E.2.

\* Seating compatible with consoles.  
\* Heating, 1°C for mobile (permanent)  
detail seat area 50° F (10° F) to  
85° F, does not discharge on crew.  
\* Ventilation 30 cu/min/man min ve-  
locity 100/min max.  
\* Effective temperature: FIG 10.F.1.  
\* Acoustical environment does not de-  
grade system effectiveness.  
\* Noise levels: FIG 10.F.2-8.  
\* Whole body vibration limits: X, Y, Z,  
time: FIG 10.F.9.

\* Exposure to gases, fumes, toxicity  
see THRESHOLD LIMIT VALUES.  
\* Impulse noise: FIG 10.G.1.  
\* Noise duration limits: FIG 10.G.3.  
\* Illumination adequate.  
\* Equipment guarded if temp exceeds  
140° F (120° F if handled).  
\* Exposed edges (corners) rounded  
0.04" (0.5° min radius).  
\* Guards provided on moving parts.

\* Adequate, suitable storage for man-  
uals, worksheets, etc.  
\* Standard work surfaces to support  
manuals, etc.  
\* Conspicuous placards adjacent to  
equipment hazardous to user.  
\* Areas requiring special equipment,  
clothing are specifically identified.  
\* Emergency procedures detailed.  
\* Instructions kept simple.  
\* Manuals, markings include warnings  
on toxic, thermal hazards of  
heaters, exhaust gas.

## 12 LINES, HOSES, CABLES

All cables, wires, lines, hoses, pipes,  
vents, etc, that pass from or to the  
test item.  
Plugs, sockets, quick-disconnect fit-  
tings for the above.  
Includes components for transport as  
well as for stationary use.

\* Conductors are bound into cables,  
held by facing tape.  
\* Long conductors, cables internal to  
equipment are clamped to chassis.  
\* Test cables terminating on control  
panel do not interfere with controls,  
displays.  
\* Reels, reel carts provided to handle  
large, heavy, long lines, cables.  
\* Covered space for cable storage.  
\* Line, cable attachment parts reach-  
able by user in bulky clothing.  
\* Cables are long enough to allow  
functioning unit to be checked con-  
veniently or extension cables pro-  
vided.  
\* Covered space for cable storage.  
\* Electrical plug size, shape coded.  
\* Cables are size, shape coded for  
similar components.

\* Hand operation or common tools  
used to tighten, loosen.  
\* Tighten CW; loosen CCW.

\* Adequate space provided to handle  
cables, lines, hoses.  
\* Clearance between cables & con-  
trols: 3" min.  
\* Cable, line, hose connectors oper-  
able by user wearing arctic mittens.

\* Line, hose, cable color contrasts  
with background.  
\* Manner of connection, disconnection  
is obvious.

\* Number of inputs, outputs are mini-  
mized by grouping functions.  
\* Cables are reachable, visible.  
\* Irregular, fragile, awkward exten-  
sions removable for handling.  
\* Cables are not pinched by doors,  
lids; walked on, used as handholds;  
bent, twisted repeatedly.  
\* Cables routed thru holes are pro-  
tected by grommets, etc.  
\* Protective caps, covers, inserts are  
available as necessary.

\* Plugs, hoses guarded if temp over  
140° F (120° F if handled).  
\* High pressure lines have retaining  
chain attached to line and source.  
\* Automatic shutoffs on fuel service  
equipment to prevent overflow, spill-  
age.  
\* Electric wiring routed away from  
lines carrying O<sub>2</sub>, flammable fluids.

\* Multiple conductors color coded.  
\* Cables labeled as to which equip-  
ment, connector they belong.  
\* Lines labeled as to function, sub-  
function, hazard, flow: FIG 12.H.1.  
\* Line color (symbol) (hazard) codes:  
FIG 12.H.2 (12.H.3) (12.H.4).  
\* Dangerous voltage placarded.  
\* Hydraulic, electric: FIG 12.H.5-6.

## 13 FASTENERS, CONNECTORS

Securing devices used to assemble,  
package or hold an item in place.  
Catches, hooks, screws, bolts, nuts,  
latches - both quick release and tool  
operated.  
Includes fastener and connector al-  
ignment and latching devices such as  
lock pins, safety wires, pins, nuts,  
electrical plugs, and fittings.

\* It is impossible to insert a wrong  
plug into a receptacle.  
\* Plugs, receptacles have aligning pins  
for insertion.  
\* Aligning pin extends beyond plug  
electrical pins.  
\* Plugs, receptacles arranged so align-  
ing pins are oriented in the same  
relative position.  
\* Fastener, connector operating parts  
are easily accessible.  
\* Alignment aids, self alignment of  
parts for fastening.  
\* Identical screw, bolt heads provided  
throughout; one removal tool.  
\* Fastener handles large enough to be  
grasped, handled.  
\* Non-interchangeable connectors for  
different use.  
\* Cotter keys snug fit, large head.  
\* Size, shape coded pins avoid mis-  
match: FIG 13.H.1.  
\* Connectors are physically different  
when lines carry different fluids.

\* Bolts requiring high torque have an  
external griphead.  
\* Fasteners, plugs require one turn  
max to tighten, loosen.  
\* Over 10 ft.-lb. torque use external  
griphead; below 10 ft.-lb. use inter-  
nal, external or combo gripheads.  
\* Quick disconnect, snap actions,  
release, twist, up to one full turn  
for frequent, critical use.  
\* Tighten CW; loosen CCW.

\* Gross (limiting) dimensions based on  
95th% (5th%) operator's hand, arm:  
FIG 25.H.4-5.  
\* Adequate space available to grasp  
connectors firmly.  
\* Adequate space to use connector  
wrench.  
\* Obstructions to use are removable.  
\* Connectors are separated by 0.75"  
(1.25" if used with bare (gloved)  
fingers).  
\* Connectors easily reached by user in  
bulky, restrictive clothing.  
\* Connectors visible, accessible.  
\* Labels, codes visible in connected,  
unconnected state.  
\* Easy visual access is provided for  
starting threads, pins.  
\* ID colors are readily discriminable  
from each other under real opera-  
tional lighting.

\* Captive fasteners used where drop-  
ping them creates hazards; covers  
needed frequent removal.  
\* Bolts have min number of turns.  
\* Only standard tools are used.  
\* Adapters for pin connectors can be  
hand tightened.  
\* Fasteners used outside are operable  
under all environmental conditions.

\* Removal of plug, connector does not  
create hot leads.  
\* Plug of one voltage rating cannot be  
inserted into the receptacle of  
another voltage rating.  
\* All hot contacts are sockets.  
\* Internal-griphead only use where  
critical to mechanical function, per-  
sonnel safety.  
\* Use captive type dust covers where  
necessary.  
\* Caps, inserts, covers, cases, shields  
provided where necessary.

\* Receptacles marked as to voltage,  
phase, frequency.  
\* Connecting plugs, receptacles iden-  
tified by color, size.  
\* Plugs, receptacles have stripes, ar-  
rows, etc to show aligning pin po-  
sition.  
\* Manner of connection obvious.  
\* Non-standard operating direction is  
clearly marked.  
\* Plus, receptacle identification: FIG  
13.H.1.

## 14 HANDLES

The special or inherent de-  
sign to grasp, hold, grip or lift a  
lifting, moving, steadying or  
handling, knobs, projectors,  
etc.

Involves roughness or no  
face when used for handling.  
Check also for the lack of

\* Handles on cabinets, ca-  
recessed.  
\* Handles, grasp areas re-  
lative to the CG.  
\* Hinged, fold-out handles h-  
position; one hand operat-  
\* Handles located so that li-  
min distance from body.  
\* Lift points on large items  
distant from the CG.  
\* Handles provided to remain  
- Handles are on front of or  
is pulled from a rack.  
\* Bar, T-bar, J-bar, recess  
FIG 14.B.1.  
\* Two handles min, or on  
grasp area for units 10 lb.  
- Hand shaped handle use  
carried frequently or  
periods.  
\* Handles reachable by 5  
wearing bulky, restrictive

\* Weight limits for one ma  
14.C.1; if shape is conver-  
dies are provided, lift  
peated, item is not carried  
Horizontal push, pull for  
FIG 14.C.2.  
\* Handle, grasp area force  
6.C.1.  
\* Two-man lift values are  
man lift only if item can  
conveniently; neither ma  
one-man limit.

\* Handles have at least 25"  
from obstructions.

\* Handles color coded to  
from similar shaped items  
\* Handles are visible from  
ing, lifting position.

\* Hand grips have nonslip su-  
\* Removable, carried unit  
with handles, other suite  
for grasping, handling, car-  
\* Handles do not interfere  
ing or maintaining item.  
\* Carried item will ride ch  
of personnel.  
\* Handles, lugs, push bars i-  
next parts of equipment a  
personnel, entangle cloth  
age equipment.  
\* Handle/grasp surfaces  
thermally/electrically car-  
\* Edges rounded attach  
recessed.

\* Items exceeding one ma  
14.C.1) are labeled with i-  
limits.  
\* Hand grasp areas identifi-



ires, lines, hoses, pipes,  
all pass from or to the  
is, quick-disconnect fit-  
ers.  
parents for transport as  
inary use.

Irreversible fastener and connector alignment and latching devices such as buck pins, safety wires, pins, nuts, electrical plugs, and fittings.

The special or inherent devices used to grasp, hold, grip or lift an item for lifting, moving, steadying or aiming. Handles, knobs, projections, straps, etc.

Involves roughened or non-slip surface when used for handling.

Check also for the lack of handles.

Components which control the operation of the item.  
Includes triggers, fuses, cranks, etc.  
Does not include controls as such, although there is some overlap.

Common and special tools and test instruments for assembly, adjustment, calibration and alignment.  
Includes special maintenance equipment such as lubrication points, pouring spouts, filter tubes and nozzles.

are bound into cables, 4 tops.  
lers, cables internal to a clamped to chassis.  
terminating on control  
interfere with controls,  
arts provided to handle  
long lines, cables.  
e for cable storage.  
Hardware parts reach-  
bulky clothing.

long enough to allow  
it to be checked con-  
extension cables pro-  
gress size, shape coded.  
ize, shape coded for  
rents.

on of certain facts  
3, loose.  
loose CCW.

are provided to handle  
uses.  
between cables & con-  
nectors are.

able color contrasts  
section, disconnection

- its outputs are mini-  
ing functions.
- hable, visible.
- is, awkward exten-  
: for handling.
- 1 pinched by doors,  
4 used as handhold;  
pestered.
- thru holes are pre-  
nets, etc.
- 4 covers, inserts are  
easy.

carded if temp over  
handled).  
lines have retaining  
a line and source.  
offs on fuel service  
event overflow, spil-  
routed away from  
flammable fluids.

fars color coded,  
as to which equip-  
ment they belong.  
s to functions, sub-  
flows FIG 12.H.1.  
Dol (Hazard) codes  
(3) (12.H.4).  
je placard.  
let FIG 12.H.5-6.

- It is impossible to insert a wrong plug into a receptacle.
- Plugs, receptacles have aligning pins for insertion.
- Aligning pin extends beyond plug.
- Aligning pins are of different sizes.
- Plugs, receptacles arranged so aligning pins are oriented in the same relative position.
- Fastener, connector aligning parts are easily accessible.
- Alignment aids, self alignment parts for fasteners.
- Identical access, both heads provided throughout are removed fast.
- Fasteners are large enough to be gripped, handled.
- Non-interchangeable connectors for different use.
- Collar keys: snug fit, large head.
- Size, shape coded pins avoid mis-connection.
- Connectors are physically different when lines carry different fluids.

- Tools requiring high torque have an external-griphead.
- Wrenches, plugs require one turn max to tighten, loosen.
- Over 10 ft.-lb. torque use external-griphead; below 10 ft.-lb. use internal, external or combi gripheads.
- Quick disconnect, snap actions, release, twist up to one full turn for frequent, critical use.
- Tighten CW; loosen CCW.

- Grasp (lifting) dimensions based on 95th/50th operator's hand, arms (fig. 23.14-5).
- Adequate space available to grasp controls safely.
- Adequate space to use connector wrench.
- (Restrictions to use are removable, connectors are separated by 0.75" (1.25") if used with bare (gloved) fingers).
- Connectors easily reached by user in bulky, restrictive clothing.
- Connectors visible, accessible.
- Labels, code's visible in connected, unconnected state.
- Easy visual access is provided for sharing threads, pins.
- Colors are readily discriminable from other under real operational conditions.

- Captive fasteners used wherever dropping them creates hazards; covers need frequent removal.
- Belts have min number of turns.
- Only standard tools are used.
- Adapters for pin connectors can be hand tightened.
- Fasteners used outside are operable under all environmental conditions.

- Removal of plug, connector does not require hot leads.
- Plug of one voltage rating cannot be connected into the receptacle of another voltage rating.
- All hot contacts are sockets.
- Internal-graphoids: only use when critical to mechanical function, permitted.
- Use captive type dust covers where necessary.
- Caps, inserts, covers, coats, shields provided where necessary.
- Receptacles identified as to voltage, phase, frequency.
- Connecting plugs, receptacles identified by color, size.
- Plugs, receptacles have stripes, arrows, etc to show aligning pin positions.
- Manner of connection obvious.
- Non-standard operating direction is clearly marked.
- Plugs, receptacle identifications FIG 10-10.

- Handles on cabinets, canisters are recessed.
- Handles, grasp areas are located relative to the CG.
- Hinged, fold-out handles have a stop position one hand operation.
- Handles located so that lifting is of min distance from body.
- Lifting points on large items are equidistant from the CG.
- Handles provided to remove cover.
- Handles are in front of an item if it is pulled from a rack.
- Bar, T-bar, J-bar, recessed handles: FIG 14.8.1.
- Two handles min, or one handle/grasp area for units 10 lbs. or more.
- Hand shaped handle used on item caps frequently or for long periods.
- Handles reachable by 5th% user wearing bulky, restrictive clothing.

- Weight limits for one man lifts: FIG 14.C.1; if shape is convenient, handles are provided, lift is not repeated, item is not carried.
- Horizontal push, pull force limits: FIG 14.C.2.
- Handle, grasp area force limits: FIG 14.C.1.
- Two-man lift values are twice one-man lift only if: item configuration convenient; neither man exceeds one-man limit.

- Handles have at least 2½" clearance from obstructions.

- Handles color coded to distinguish from similar shaped items.
- Handles are visible from the grasping, lifting position.

- Hand grips have nonslip surface.
- Removable, carried units provided with handles, either suitable means for grasping, handling, carrying.
- Handles do not interfere with operating or maintaining item.
- Carried items will ride clear of legs of personnel.
- Handles, lugs, push bars are permanent parts of equipment case.
- Removable handles do not injure personnel, entangle clothing, damage equipment.
- Handle/grasp surfaces are not thermally/electrically conductive.
- Edges rounded; attaching screws recessed.

- Items exceeding one man lift (FIG 14.C.1) are labeled with weight, lift limits.
- Hand cross areas identified.

- Controls used only for maintenance, adjustment are covered during normal operation but are accessible, visible when required.
- Foot controls are not used for precise adjustments.
- Lift, attachment points accessible, equidistant from CG.

- Safety catches have a distinctive shape, location.
- Shape, size is aid to function.

- Units frequently pulled out of installed position mounted on pullout racks, slides, hinges.
- Rollouts provided with limit stops.
- Use of pullouts does not shift CG of item so entire rack, console falls.
- Knobs preferred over screwdriver for frequent adjustment.

- Compatible with handwear used.
- Self alignment devices provided for remotely handled items.
- Full hand, tool clearance at all fastening points.
- Moving components have 2" hand clearance throughout range.

- Tie-down points visible for checking.
- Operated elements must be visible when accessed, especially if hazards present.
- Elements that are mated are color or shape coded.

- Hoist points provided for mechanical lifting.
- Frequently used elements are within easy reach of seated or standing station position.
- Special tools for handling, tie-down are avoided.

- Internal controls are not located near high voltage, rotating machinery, other hazards.
- Handles, lift points distributed evenly.
- Projections, edges, corners around tie down or lift points are rounded, padded, or eliminated.
- Electrical, thermal, mechanical hazards near location where user's hand must access are shielded.
- Safety catches have positive action, attend.
- CG, weight of equipment marked, where applicable.
- Weight capacity indicated on all lifting equipment.
- Items exceeding one-man lift value, labeled as to weight, lift limitation.
- Control warning label located near
- Air dropped items have quick release capability.

- Cables terminating on control, display panels do not interfere with controls, displays.
- Test points reflect the sequence for sequential testing.
- Test points for adjustment are close to the controls, displays used.
- Special tools required for adjustment are with equipment.
- Test points are accessible.
- Test points, built-in meters used to isolate failed unit, module.

- Limiting body dimensions based on 5th% user for reaching test points: FIG 25.B.1.
- Sensitive adjustment points have a hand, arm rest nearby if vibration is present during adjustment.
- Cables are long enough to check unit in place.
- Braces hold hinged assys in working position.
- Test equipment fits the hand or has handle, hand support.

- Calibration, adjustment controls with limited motion have mechanical stops to prevent damage.
- Built-in aligning devices, other aids are used for positioning optical assemblies within instrument.
- Rollout racks do not shift CG to extent that console topples.
- Quick-release removal for optics.
- Stands, casters (wheels, hoist-lifting) is provided for equipment exceeding 30 lb (90 lb).

- Adequate storage provided in portable test equipment case, lid to contain leads, probes, spores, manuals, tools.
- Large ports are not mounted to deny access to smaller ones.
- Sufficient space provided for test equipment, tool use without difficulty, hazard.
- Optics purging, charging fittings are accessible.

- Indication of equipment power failure provided.
- Display provided to show equipment out-of-tolerance, failure.
- Test, adjustment, check point and cables, connectors, labels are accessible, visible during maintenance.
- Positive indication of open fuse.
- Non-visual screwdriver adjustments have mechanical shaft guide.
- Test equipment has panel lighting.

- Enough test points are provided to prevent removing sub-assemblies.
- Special tool use minimized.
- Items to be removed for tests are mounted on rollout racks, slides, hinges.
- Knobs preferred to screwdriver for frequent adjustment.
- Lamp test circuits incorporated.
- Lamp replacement is possible with power on, from panel front.
- Test equipment is not overly complex, difficult to use.
- Electrical potentials over 300V are stepped down for test points.
- Tools, test leads used near high voltages are insulated.
- Electrical hand-held tools have 3-wire power with ground or are dual-insulated.
- Exposed surfaces of electrical hand-held tools are non-conducting or grounded.
- Contacts, terminals are shielded with suitable protective measures to prevent accidental contact.
- Test points permanently labeled, color coded.
- Operating instructions for portable test equipment affixed to unit, lid or compartment.
- Calibration reminder included with test instructions.
- Contacts, terminals, etc over 500V are clearly labeled.
- Reference scale is provided for control adjustment.
- A visual check shows when equipment is out of calibration.

- Design Requirements (MIL-STD-1472)
- User-Computer Interface Data (MIL-STD-1472C)
- Guidance Data (MIL-HDBK-759, Etc.)



TEST FUNCTION \_\_\_\_\_

TEST ITEM CLASS V \_\_\_\_\_

SUBCLASS B \_\_\_\_\_

MATERIEL PRODUCT \_\_\_\_\_

OBJECTIVE: Evaluate the effectiveness and safety of the design of materiel production and environmental control systems and equipment to enable the operator to assemble and set up the item, prepare it for use, and actually use it. The HFE subtest should consider evaluation of user performance and safety for these functions under conditions representative of those expected in actual use.

The conditions apply

1. User conditions - b
2. Environmental conditions
3. Operational conditions - rates, types of mix and time critical a

| ASSEMBLE/SET UP  |  | PREPARE FOR USE   |  |
|--|--|---|--|
| ASSEMBLE/DISASSEMBLE   | EMPLACE  | ALIGN/CALIBRATE/ADJUST  |  |
| <p>PURPOSE: Evaluate the design of the test item for ease and safety of assembling component parts and for the procedural guidance provided.</p> <p>MAN/ITEM TASKS</p> <p>Unstow/stow components.</p> <p>Read/interpret instructions/technical manuals.</p> <p>Identify parts.</p> <p>Connect components.</p> <p>Mate components to chassis.</p> | <p>PURPOSE: Evaluate the design of the test item for ease of situating the item in its use area and connecting vent pipes, power cables, liquid hoses and pipes.</p> <p>MAN/ITEM TASKS</p> <p>Install subassemblies.</p> <p>Make connections.</p> <p>Position for use.</p> | <p>PURPOSE: Evaluate the design of the test item for ease and reliability of performing alignment and calibration of operating components.</p> <p>MAN/ITEM TASKS</p> <p>Interpret technical manual/labels.</p> <p>Tighten/loosen fasteners.</p> <p>Set/adjust controls.</p> | <p>PURPOSE: Evaluate the design of the test item for ease of obtaining of materiel.</p> <p>MAN/ITEM TASKS</p> <p>Determine s</p> <p>Open/close</p> <p>Remove/rep</p> |

## INDEX TO DETAILED DESIGN CONSIDERATIONS

| Test Item Components<br>HUMAN FACTORS<br>CONSIDERATIONS | Labels<br>Manuals<br>Markings<br>(1) | Fasteners<br>Connectors<br>(13) | Handles<br>(14) | Lines<br>Hoses<br>Cables<br>(12) | Fastener<br>Conne-<br>ctors<br>(13) | Handles<br>(14) | Controls<br>(6) | Displays<br>(8) | Workspace<br>(10) | Fasteners<br>Connectors<br>(13) | Display<br>(8) |
|---|--------------------------------------|---------------------------------|-----------------|----------------------------------|-------------------------------------|-----------------|-----------------|-----------------|-------------------|---------------------------------|----------------|
| A. LOCATION & ARRANGEMENT                               | A                                    | A                               | A               | A                                | A                                   | A               | A               | A               | A                 | A                               | A              |
| B. SIZE & SHAPE   | B                                    | B                               | B               | B                                | B                                   | B               | B               | B               | B                 | B                               | B              |
| C. DIRECTION & FORCE                                    | C                                    | C                               | C               | C                                | C                                   | C               | C               | C               | C                 | C                               | C              |
| D. CLEARANCE  | D                                    | D                               | D               | D                                | D                                   | D               | D               | D               | D                 | D                               | D              |
| E. VISIBILITY   | E                                    | E                               | E               | E                                | E                                   | E               | E               | E               | E                 | E                               | E              |
| F. USE CONDITIONS                                       | F                                    | F                               | F               | F                                | F                                   | F               | F               | F               | F                 | F                               | F              |
| G. SAFETY   | G                                    | G                               | G               | G                                | G                                   | G               | G               | G               | G                 | G                               | G              |
| H. OPERATING PROCEDURES                                 | H                                    | H                               | H               | H                                | H                                   | H               | H               | H               | H                 | H                               | H              |



## OPERABILITY

### OPERATIONAL SUPPORT

### MATERIAL PRODUCTION & ENVIRONMENT CONTROL

ity of  
mental  
tor to  
, and  
sider  
these  
e ex-

The conditions applicable to this class includes

1. User conditions - body size and clothing;
2. Environmental conditions - weather, climate and illumination levels;
3. Operational conditions - use conditions (duration of use, through put rates, types of material or environments to be produced or modified) and time critical operations (quick response).

| PREPARE FOR USE                             |   | USE  |   |
|---|---|--|---|
| ADJUST                                      | SERVICE   | ACTIVATE/DEACTIVATE  | PERFORM PRIME FUNCTION  |
| design of the reliability of calibration of | <p>PURPOSE: Evaluate the design of test item for ease and safety of loading raw materials, adding liquids, and storing and obtaining operating quantities of necessary materials.</p> <p>MAN/ITEM TASKS</p> <p>Determine status of expendables.</p> <p>Open/close access covers.</p> <p>Remove/replace filler caps.</p> | <p>PURPOSE: Evaluate the design of the test item for the operation of the tasks required.</p> <p>MAN/ITEM TASKS</p> <p>Start gasoline engines.</p> <p>Ignite pilot light/burner.</p> <p>Turn on electrical power.</p> <p>Initiate air/hydraulic power.</p> | <p>PURPOSE: Evaluate the design of the test item for performance of the tasks required to produce or service materials, modify environment, or generate power.</p> <p>MAN/ITEM TASKS</p> <p>Operate equipment according to operating manuals.</p> <p>Manipulate controls.</p> <p>Observe/monitor displays.</p> <p>Perform manual/tool assisted operations.</p> <p>Observe/test status of materials.</p> <p>Remove/inspect finished product.</p> |

### DETAILED DESIGN CONSIDERATIONS

| Fasteners<br>Connectors<br>(13) | Displays<br>(8) | Access<br>Covers<br>Caps<br>(19) | Controls<br>(6) | Displays<br>(8) | Operating<br>Elements<br>(16) | Controls<br>(6) | Displays<br>(8) |
|---------------------------------|-----------------|----------------------------------|-----------------|-----------------|-------------------------------|-----------------|-----------------|
| A                               | A               | A                                | A               | A               | A                             | A               | A               |
| B                               | B               | B                                | B               | B               | B                             | B               | B               |
| C                               |                 | C                                | C               |                 | C                             | C               |                 |
| D                               |                 | D                                | D               |                 | D                             | D               |                 |
| E                               | E               | E                                | E               | E               | E                             | E               | E               |
| F                               | F               | F                                | F               | F               | F                             | F               | F               |
| G                               | G               | G                                | G               | G               | G                             | G               | G               |
| H                               | H               | H                                | H               | H               | H                             | H               | H               |



## TEST ITEM COMPONENTS

### HUMAN FACTORS CONSIDERATIONS

#### A LOCATION & ALIGNMENT

The positioning of a component as it affects the ability of the operator to reach, operate or manipulate it, including location of openings (access), cover or clear operation, location of components (knobs, levers, etc.) as well as its relationship to other components.

#### B SIZE & SHAPE

The maximum and/or minimum dimensions of a component that are required for adequate man use, including the effects of anthropometric and special clothing (e.g., NBC) considerations, and the shape and contour of handles, knobs and other controls to enhance both the identification and use of the component.

#### C DIRECTION & FORCE

The movement and/or force required to operate or generally manipulate a component (handle, control, fastener, etc.), with emphasis on the direction of motion corresponding to the display, component, total item reaction or function as well as the minimum strength required.

#### D CLEARANCE

The unobstructed space surrounding a component which allows the operator to perform required actions, the adequacy of which varies as a function of the amount of body involved (arms, legs, torso, etc.), and, where appropriate, will also include considerations such as gloves, boots, helmets, protective clothing, etc.

#### E VISIBILITY

Those aspects of a component that contribute to the operator's ability to see it clearly, including location, size, shape, color, contrast, field of view, viewing distance, reflectance, and illumination.

#### F USE CONDITIONS

Those aspects of a component that pertain to its operational status before, during and after use, as well as the maintenance of an acceptable environment in the workspace areas.

#### G SAFETY

Those aspects of a component that could cause injury to the operator or other personnel, including preventative aspects for bad weather or reduced visibility, accidental contact with electrical, temperature, chemical, radiation and pressurization hazards, and danger to sight and hearing, particularly under the conditions of alert or battle stress.

#### H OPERATING PROCEDURES

Those operational and informational aspects affecting or improving man performance as based in equipment design handbooks as well as job aids, checklists, training texts, troubleshooting guides and repair manuals with specific attention to the safety aspects when using the components.

## 1 LABELS, MANUALS, MARKINGS

Provide technical guidance in the form of written material, schematics, diagrams, illustrations and instruction plates. Make operator aware of hazards. Give special guidance or instructions.

- Controls, displays, etc. are clearly, appropriately labeled except where use is obvious.
- Labels placed on or near items they identify.
- Do not cover other information.
- Label is not behind control.
- Label location consistent.
- Labels not obscured by components on flat test surface; on main chassis, min coverage by grimes; not easily removed.

- Character height determined by distance read, luminance: FIG 1.B.1.
- Group label characters larger than those of controls, displays which are larger than control, display position characters: each by 25% min.
- Letter, numeral styles: FIG 1.B.2.4.
- Height-width ratio: 5:3; "M" is 1 stroke width wider; "W" is 1 stroke width; "I" and "l" are 1 stroke width.
- Stroke width for black (white) characters on light (black) background: 1/6 (1/7-1/8) of height.

- Design Requirements (MIL-STD-1472)
- User-Computer Interface Data (MIL-STD-1472C)
- Guidance Data (MIL-HDBK-759, Etc.)

- Spacing between characters (words): one stroke (character) width min.
- Line spacing: 1/2 character height.
- Counter numeral row ratio: 1:1 (except 1:2 separation: 1/2 to 1/4).
- Optical projections: all caps, stroke width 1/6 min; 1/8 in excess 15 min; vertical min.
- Thumbwheel numeral row ratio: 3:2; h: 1/4; stroke width internally (externally) illuminated: 1:0.1 (5:1).
- Abbreviations all caps, no periods.
- Extended copy uses lower case.
- Label characteristics determined by illumination level, color.
- Labels easily, accurately read at operational reading distance, vibration, light levels, environments.
- Labels are sharp with high or color contrast.
- With illumination above 1 ft-cd: black letters, light background.
- Dark adaptation: letters visible, do not interfere with night vision.
- Chart reading: FIG 1.B.1.3.

- Label characteristics accuracy required: time available; distance; light level; color; criticality of function; consistency of design.
- Labels on production equipment are as durable as the equipment.
- Labels for prototype equipment easily affixed, altered, removed.
- Labels not covered by other units nor obscured by grease, dirt.
- Markings, tags are as permanent, washable as equipment.
- Roman numerals avoided.
- Vertical labels used only when labels are not critical for personnel safety, performance.
- Warning placards illuminated.
- Warning notices clear, direct; characters 25% larger than any following instructions.
- Placards adjacent to hazards.

- Abbreviations are standard (MIL-STD-121); new OK if obvious.
- Trade names, irrelevant info do not appear on labeling.
- Labels concise; min redundancy.
- Abstract symbol only if meaningful.
- Words familiar to user.
- Hand grasp areas identified.

## 6 CONTROLS

Components used to activate, deactivate and modify the equipment power source and to modulate the operating elements. Handles, grips, knobs, switches, triggers, levers, wheels, pedals and other man-operated items as applicable. Controls are associated only with the item under test, not with equipment placed on it.

- Control relationship to its display is apparent, compatible.
- Functionally related controls are grouped together.
- Control groups, sequential operations have left-to-right and/or top-to-bottom order of use.
- Controls in functional groups are located in accordance with operational sequence and/or function.
- Controls oriented to operator.
- Can not accidentally be moved.
- Recurring groups similar thru system.
- Controls used for same function on different equipment are same size.
- Rotary size, shape: FIG 6.B.1.6.
- Linear size, shape: FIG 6.B.1.7.
- Controls have non-slip surfaces.
- Gross (limiting) (adjustable) dimensions based on 95th (5th) (5-95th) operation.
- Linear size, shape: FIG 6.B.9.16.
- Grid & stylus: displaced grids, display same size; mounted/oriented below display; preserve directional correlation.
- Adequate control response feedback.
- Rotary valves open CCW.
- Forces, displacements (including miniature controls): FIG 6.B.1-16.
- High force controls: FIG 6.C.1-2.
- Free from excessive backlash.

- Control spacing min: FIG 6.D.1; blind operation, 5" min.
- Rotary separation: FIG 6.D.1-8.
- Linear separation: FIG 6.D.9-16.
- Compatible with hardware used.
- Foot switches: separated 3" horizontally, 8" vertically minimum.
- Range of control action does not interfere with other controls.
- Larger diameter concentric control is used for the fine adjustment.

- Shape coded controls visually, tactually identifiable.
- Color contrasts with background.
- Ambient light color determines useable control colors.
- Reference line has 50% min contrast with control color.
- Thumbwheel internally lighted if ambient illumination below 1 ft-cd.
- Thumbwheel readable 30° off-axis.
- Legend switch legend is legible.

- Precision of control manipulation is consistent with that of system.
- Selected, distributed so none of user's limbs are overburdened.
- Coding uniform throughout system.
- Useable in time required despite inadvertent operation protection.
- Movement oriented to operator if several stations are used.
- Control motion mini-sized not cycled thru ON/OFF unnecessarily.
- Minimum use made of horizontal or 3-position toggle switches.
- Shape coding free of sharp edges.
- Critical controls are not susceptible to accidental movement.
- Controls that initiate hazardous operations require prior operation of a locking control.
- Main power ON/OFF switch cuts all power to equipment.
- Emergency controls located near related warning display/nearest hand.

- Minimum decoding required.
- Control color related to display.
- Operating instructions provided except where use is obvious.
- Diagrams used where possible.
- Main power switch labeled.
- Emergency (noncritical) functional groups outlined with 3/16" red (1/16" black) border.
- Controls labeled as to function.

## 8 DISPLAYS

Components that provide visual and auditory information to the operator concerning the status of operation. Provide positive indication of developing or current malfunctions. Displays are associated only with the item under test, not with equipment placed in or on it.

- Display relationship to control is apparent; determines control used, equipment displayed.
- Functionally related units grouped.
- Displays, groups have left-to-right and/or top-to-bottom order of use.
- Displays located in order can be read to the required degree of accuracy.
- Positions of related controls, displays on separate panels correspond.
- Lighted control indicators are unambiguously associated with controls.
- Display viewing distance: 13-28".
- Pointer extends to but does not obscure or exceed index mark width.
- Pointers are close to dial to eliminate parallax, shadows.
- CRT target visual angle exceeds 2.0 minutes, 10 lines of resolution; distance 16" (10" min).

- Display face to line of sight exceeds 45° min parallax, reflection.
- Frequently used displays grouped; in optimal visual zone: FIG 8.B.1.
- Illumination uniform: FIG 8.E.3.
- Indicator lights show response, used sparingly, visible.
- Contrast, luminance exceeds 50%.
- Flashing lights: 3-5 flashes/sec.
- Color coding used where possible; unused scales covered.
- Display pointer tip same color as marker.

- Display precision, response is consistent with that of system.
- Information displayed: Clear, specific, precise, useable; not redundant, degraded by vibration.
- Lights show function: FIG 8.F.1.
- Scales: linear, start at 0, use whole numbers, 2 pointers max, numerals oriented upright.
- Mechanical types: FIG 8.F.2.
- Audio signal evaluations: FIG 8.F.3.
- Audio, verbal warnings: 20 dB min above background.
- Failure immediately apparent.
- Signal absence does not mean "go".
- Indicator light color coding for emergency, warning, summation, etc: FIG 8.F.1; master lights set apart.
- Audio warnings transmitted to both earphones and work area.
- Audio signal action segment specifies nature of problem.
- Prohibited, persistent signals are not used: FIG 8.G.1.
- Audio warning durations min of 1/2 sec; until corrective action takes.
- Minimum decoding required.
- Trademarks, irrelevant information, etc do not appear on panel face.
- Coding techniques uniform; facilitate discrimination, identification, relationship, criticality.
- Reliability displays used when vision overburdened, degraded redundancy desirable; warning, cue needed.
- Verbal warnings: intelligible, apt.
- Audio warnings use standard signals.
- Labels: functional; basic; well located; graduated in size.

- Display face to line of sight exceeds 45° min parallax, reflection.
- Frequently used displays grouped; in optimal visual zone: FIG 8.B.1.
- Illumination uniform: FIG 8.E.3.
- Indicator lights show response, used sparingly, visible.
- Contrast, luminance exceeds 50%.
- Flashing lights: 3-5 flashes/sec.
- Color coding used where possible; unused scales covered.
- Display pointer tip same color as marker.

- Seating compatible with consoles.
- Heating, A/C for man (permanent) heat work areas: 50° F (65° F) to 85° F, does not discharge on crew.
- Ventilation: 30 cu ft/min/man min; velocity 100 ft/min max.
- Effective temperatures: FIG 10.F.1.
- Acoustical environment does not degrade system effectiveness.
- Noise levels: FIG 10.F.2-8.
- Room sound absorption: 0.20 min.
- Whole body vibration limits: X, Y, Z, times FIG 10.F.9.
- Exposure to gases, fumes, toxicity: see THRESHOLD LIMIT VALUES.
- Impulse noise: FIG 10.G.1.
- Noise duration limits: FIG 10.G.3.
- Hazard alerting device provided.
- Illumination adequate.
- Equipment guarded if temp exceeds 140° F (120° F if handled).
- Exposed edges (corners) rounded: 0.04" (0.07" min radius).
- Guards provided on moving parts.
- Radiation hazards minimized.
- Maximum sickness limits: FIG 10.G.4.
- Advancers, suitable storage for manuals, worksheets, etc.
- Standards have work surfaces to support manuals, etc.
- Lifters, hydraulic lifts have max load sign visible.
- Compensatory placards adjacent to equipment hazardous to man.
- Areas requiring special equipment, clothing are specifically identified.
- Emergency procedures detailed.

## 10 WORKSPACE

The area within which the user operates the equipment. Includes space for controls, displays, optics, electronic devices, weapons and man as well as standing areas, consoles and seats. Provides storage for excess clothing, personal gear, weapons and tools. Protects operator from adverse environment, when applicable.

- Display placement above standing (seated) surface: normal, 41-70" (6-46"); precisely, frequently read, 50-65" (14-35"); 2" from centerline.
- Controls on vertical surface above floor (seated) normal, 34-70" (8-34"); precisely, frequently used, 34-51" (8-27"); 2" from user centerline.
- Work surface height: standing, 36 ± 1/2"; seated, 29-31".
- Desk tops, writing tables are 29-31" above floor.
- Display reading location identified.
- Seats fit suitably clothed 5-95th % user without degrading performance.
- Armrests 2-8" min.
- Back seat have 1" min padding.
- If van occupancy exceeds 1 hr: ceiling height 78" min.
- Lateral work (writing) space: 30x16" (24x14" min).
- Shoulder console: FIG 10.B.1-3.
- Gross (limiting) dimensions based on 95th (5th) % fully equipped user: FIG 25.B.1-7. Aerics: FIG 25.B.8.
- Adjustable dimensions fit 5-95th %.
- Vertical seat adjustment: 15-21" in 1" increments.
- Seat backrest reclines 103-115°; supports torso so operator's eyes are within 3" of "eye-line".
- If arms adjust: 75-11" above seat.
- Seat adjusts fore, aft: 4" min.
- Operator does not have to lift self to adjust seat.

- Cabinet kick space: 4x4" x 4" min.
- Console front floor space: 4" min.
- Knee room 25x20x18" min.
- Unusual positions: FIG 10.D.1-2.
- Alliances made for heavy clothing, protective equipment.
- Workspace anthropometrics: FIG 10.D.1-2.
- Seat adjustment overhead clearance from seat pan: 40" min.
- Sufficient clearance for use with gloves, arctic mitts, heavy clothing.
- User space not encroached upon by others.
- Reflection of instruments, consoles in windows, windshields avoided.
- Right-left viewing angle for wrap-around consoles: 180° max.
- Illuminations: FIG 10.E.1.
- Surface colors conform to MIL-STD-1472.
- Reflectances: FIG 10.E.3.

- Thickness of equipment group
- Cables are neat
- Irregular, frag
- Cables are not
- lights, walked or
- bench, twisted or
- Cables routed
- tested by group
- Protective cap
- available in new
- Pipes, hoses @
- 100° (120°)
- High pressure
- chain attached
- Automatic shu
- equipment to p
- page.
- Electric wiring
- lines carrying C
- Multiple conne
- Cables labeled
- ment, names to
- Lines labeled
- function, hazard
- ID tapes marked
- ID tags, hands
- stainless steel
- ID point used a
- Line color (see
- FIG 12.H.2 (12)
- Dangerous volta
- Hydraulic, elec

## 12 LIFE SUPPORT

All cables, wires, vents, etc. that test items. This, sockets, ready for the show in tubes, cones, well as for shelter

- Conduits are held by locking
- Long, flexible equipment are
- Test cables to panel do not in
- displays.
- Heels, heel cur
- torque, better, in
- Control uses
- Cable clamps u
- Lines, cable att
- able by user
- Cables are in
- functioning un
- veniently or
- wired.
- Electric transp
- Cables are s
- similar compen

- Hand operation used to tighten
- Lighten (W) h

- Adequate spa
- cables, lines, b
- Clearance bet
- trials: 3" min
- Cable, line, b
- able to user
- ID tapes visu
- able; near vent
- Bands, tags, p
- valves, regulat
- checks, clean
- intervals & a
- balls, floors.
- Line, base, c
- with background
- Manner of con
- is obvious.



**19 ACCESS, COVERS, CAPS**

Those openings in an item that allow manipulation of controls, connection and disconnection of fasteners, visual checking of displays or components, utilizing test points, and inserting or removing materials.

Included is the access covering, if any.

- Sliding, rotating, hinged units open, rotate their full distance, remain in place without hand support.
- Covers have mounting holes large enough to permit the attaching screws to pass without perfect alignment.

- Covers not completely removable or self supporting.
- Access large enough to insert arm, hand, tools, test equipment.
- Rubber stripping, sealing material located so user will not damage it.
- Girth (limiting) dimensions based on 95th% (5th%) users: FIG 25.B.1-7.
- Whole body access: FIG 25.B.1.
- Hand, arm, finger access: FIG 19.B.1, 19.B.1.
- Construction max hinders: FIG 19.B.2.
- Requirements to see, walk within access determines opening size.
- (limited arm, finger): FIG 25.B.8.

- Structural members do not prevent access to components.
- Replaceable items are not placed in a manner which makes them difficult to remove.
- Small covers hinge at bottom, open down.
- Cover latch requires positive force to open, is within capability of 5th% users FIG 6.C.1.
- Caps tighten CCW, loosen CCW.
- One man can lift cover.

- Bulkheads, brackets don't interfere with opening, removing covers where work is done.
- Openings are large enough to permit required operations.
- Allowance is made for gloved hand in externally located access.
- Open covers do not interfere with controls, displays.

- Visual access cover preference: none, transparent, break-resistant glass, quick opening metal.
- It is obvious when a cover is in place but not secured.
- Visual access only for components requiring a visual check.
- Instructions visible when access cover is open.
- Openings allow visibility of internal components while operator performs tests.

- Access covers are equipped with grasp areas for opening.
- Physical access cover preferences: none, sliding, hinged, quick-opening.
- Captive fasteners used when periodic removal is required.
- Either hinged cover used or minimum number of captive fasteners.
- Cover fasteners self lock for closing with audible snap.
- Replaceable caps captive.
- Sliding doors, caps lock positively.

- Edges, corners on covers, cases are rounded to prevent injury.
- Hazardous voltage behind access cover is de-energized with an interlock attached to cover.
- Access over dangerous mechanical, electrical component has an internal light, warning on door.
- Pressurized areas are caution.

- Cover opening method is obvious or instructions are displayed on outside of cover.
- Accessories are labeled with warning sign advertising of hazards within, precautions needed.
- Labels indicate function of units behind enclosure, access.
- Labels, instructions are properly oriented when cover, case, door is open.
- Labels indicate how service equip-



TEST FUNCTION \_\_\_\_\_

TEST ITEM CLASS VI \_\_\_\_\_ T

SUBCLASS A \_\_\_\_\_

OBJECTIVE: Evaluate the effectiveness and safety of the design of consumables to enable the user to unpackage or repackage them, prepare them for use, and use or consume them. The HFE subtest should consider evaluation of user performance and safety for these functions under conditions representative of those expected in actual use.

The conditions applicable to:

1. User conditions - number of
2. Environmental conditions - w
3. Operational conditions - diff

| UNPACKAGE/PACKAGE   |   | PREPARE FOR USE   |  |
|---|---|---|--|
| STOW/UNSTOW   | OPEN/CLOSE PACKAGE  | PREMIX  | HEAT   |
| <p>PURPOSE: Evaluate the design of the test item for ease of attachment, insertion, and removal from person, for individually carried items, or from storage, for general removal of garrison mess types of items.</p> <p>MAN/ITEM TASKS</p> <p>Insert item into/remove item from carrying case.</p> <p>Place item in/remove item from pockets/shirt/pack.</p> <p>Strap/connect item to personal carrying gear.</p> <p>Remove large item from storage area.</p> | <p>PURPOSE: Evaluate the item package for ease and safety of opening to gain access to the item and for reclosing to retain remaining material.</p> <p>MAN/ITEM TASKS</p> <p>Rip/tear plastic/foil/paper sacks/envelopes.</p> <p>Open/pierce metal/plastic containers (not recloseable).</p> <p>Remove/replace caps/covers.</p> | <p>PURPOSE: Evaluate the test item for adequacy of containers and for instructions for the addition of water or combination with other materials.</p> <p>MAN/ITEM TASKS</p> <p>Measure water/other liquids.</p> <p>Measure dry materials.</p> <p>Add liquid/dry materials in correct proportions.</p> | <p>PURPOSE: Evaluate safety and conversion of final food or other such as heating, stirring.</p> <p>MAN/ITEM TASKS</p> <p>Place item over fire.</p> <p>Empty consumable utensil.</p> <p>Stir material.</p> <p>Agitate package.</p> |

INDEX TO DETAILED DESIGN CONSIDERATIONS

| Test Item Components<br>HUMAN FACTORS<br>CONSIDERATIONS | Labels<br>Manuals<br>Markings<br>(1) | Handles<br>(14) | Packaging<br>(17) | Accesses<br>Covers<br>Caps<br>(19) | Labels<br>Manuals<br>Markings<br>(1) | Measures<br>(20) | Labels<br>Manuals<br>Markings<br>(1) |
|---|--------------------------------------|-----------------|-------------------|------------------------------------|--------------------------------------|------------------|--------------------------------------|
| A. LOCATION & ARRANGEMENT                               | A                                    | A               | A                 | A                                  | A                                    | A                | A                                    |
| B. SIZE & SHAPE   | B                                    | B               | B                 | B                                  | B                                    | B                | B                                    |
| C. DIRECTION & FORCE                                    |                                      | C               | C                 | C                                  |                                      |                  |                                      |
| D. CLEARANCE  | D                                    | D               | D                 | D                                  | D                                    | D                | D                                    |
| E. VISIBILITY   | E                                    | E               | E                 | E                                  | E                                    | E                | E                                    |
| F. USE CONDITIONS                                       | F                                    | F               | F                 | F                                  | F                                    | F                | F                                    |
| G. SAFETY   | G                                    | G               | G                 | G                                  | G                                    | G                | G                                    |
| H. OPERATING PROCEDURES                                 | H                                    | H               | H                 | H                                  | H                                    | H                | H                                    |



# OPERABILITY

## TROOP SUPPORT EQUIPMENT

### CONSUMABLES

The conditions applicable to this class includes:

1. User conditions - number of users;
2. Environmental conditions - weather, temperature, illuminations;
3. Operational conditions - different uses, different packaging, time critical operations and combat conditions (blackout, noise suppression).

| PREPARE FOR USE                          |   | USE/CONSUME  |  |
|--|---|--|--|
|  | HEAT/AGITATE  | APPLY/REMOVE   | INGEST   |
| test item for 1 for instructor or combi- | <p>PURPOSE: Evaluate the test item for safety and convenience of performance of final food or drink preparation steps, such as heating, stirring and shaking.</p> | <p>PURPOSE: Evaluate the test item for ease and convenience of spreading or applying oils, salves, and powders to the body and of its subsequent removal, if required.</p> | <p>PURPOSE: Evaluate food, drink and oral medicines for palatability and general troop acceptance.</p> |
|  | <p>MAN/ITEM TASKS</p> <p>Place item over fire or in hot water.</p>  | <p>MAN/ITEM TASKS</p> <p>Remove/replace cap/cover.</p>   | <p>MAN/ITEM TASKS</p> <p>Eat/drink item.</p>   |
|  | <p>Empty consumable into cooking/eating utensil.</p>  | <p>Obtain/prepare applicator.</p>  | <p>Utilize pouring/drinking spout.</p>   |
| correct pro-                             | <p>Stir material.</p>   | <p>Clean/prepare skin.</p>   | <p>Dispose of wastes.</p>  |
|  | <p>Agitate package.</p>   | <p>Apply/remove salve/oil.</p>   |  |
|  |   | <p>Sprinkle/spread powder.</p>   |  |

### DETAILED DESIGN CONSIDERATIONS

| Measures (20) | Labels Manuals Markings (1) | Handles (14) | Labels Manuals Markings (1) | Accessories Covers Caps (12) | Handles (14) | Packaging (17) |
|---------------|-----------------------------|--------------|-----------------------------|------------------------------|--------------|----------------|
| A             | A                           | A            | A                           | A                            | A            | A              |
| B             | B                           | B            | B                           | B                            | B            | B              |
|               |                             | C            |                             | C                            | C            | C              |
| D             | D                           | D            | D                           | D                            | D            | D              |
| E             | E                           | E            | E                           | E                            | E            | E              |
| F             | F                           | F            | F                           | F                            | F            | F              |
| G             | G                           | G            | G                           | G                            | G            | G              |
| H             | H                           | H            | H                           | H                            | H            | H              |



## HEAVYWEIGHT EQUIPMENT

### A LOCATION AND IDENTIFICATION

The position of a component as it affects the ability of the operator to reach, operate or manipulate it, including location of operating levers, switches, control or display knobs, location of components (levers, buttons, etc.) as well as its relationship to other components.

### B SIZE AND SHAPE

The maximum and/or minimum dimensions of components that are required for adequate man-machine interface, including the effects of anthropometric and spatial constraints (reach, sight, control, etc.) and the shape and control of handles, knobs, and other controls to achieve both the identification and the use of the component.

### C POSITION AND FORCE

The movement and/or force required to operate or manipulate a component (handle, control, fastener, etc.) with emphasis on the direction of motion corresponding to the display, component, total item reaction or standard practice as well as the minimum strength required.

### D CLARITY

The unobstructed view surrounding a component which allows the operator to perform required actions, including a full view of the function of the component (handles, knobs, etc.) and, where appropriate, will also include considerations such as glare, fog, helmets, protective clothing, etc.

### E VISIBILITY

Those aspects of a component that contribute to the operator's ability to see it clearly, including location, size, shape, color, contrast, field of view, viewing distance, reflectance, and illumination.

### F USE CONDITIONS

Those aspects of a component that pertain to its operational status before, during and after use, as well as the maintenance of an acceptable environment in the workspace areas.

### G SAFETY

Those aspects of a component that could cause injury to the operator or other personnel, including preventative aspects for bad weather or reduced visibility, accidental contact with electrical, temperature, chemical, radiation and pressure hazards, and danger to sight and hearing, particularly under the conditions of alert or battle stress.

### H OPERATING PROCEDURES

Those operational and informational aspects affecting or improving man-machine interface as found in equipment design handbooks as well as placards, checklists, training facts, troubleshooting guides and repair manuals which draw attention to the safety aspects of using the components.

## 1 LABELS, MATERIAL, MARKINGS

Provide technical guidance in the form of written material, schematics, diagrams, illustrations and instruction placards. Make operator aware of hazards. Give special guidance or instructions.

- Controls, displays, etc. are clearly, appropriately labeled except where use is obvious.
- Labels placed on or near items they identify.
- Do not cover other information.
- Label is not behind control.
- Label location consistent.
- ID labels not obscured by components on flat surfaces; on main chassis; min coverage by grimes not easily removed.

- Character height determined by distance read, luminance: FIG 1.B.1.
- Group label characters larger than those of controls, displays which are larger than control, display position characters: each by 25% min.
- Letter, numeral styles: FIG 1.B.2.4.
- Height/width ratio: 5/3; "H" is 1 stroke width wider; "M" & "W" low 5/6; "I" & "L" are 1 stroke width.
- Stroke width for black (white) characters on light (black) background: 1/8 (1/7-1/8) of height.

- Spacing between characters (words): one stroke (character) width min.
- Line spacing: 1/2 character height.
- Counter numeral low ratio: 1:1 (except 13 separation: 4 to 1 w).
- Optical projection: all caps, stroke width 1/6 to 1/8 h; exceeds 15 minutes visual angle.
- Thumwheel numeral low ratio: 1:2; h 1/2 stroke width internally externally illuminated: 10:1 (5:1). Abbreviations all caps, no periods.
- Extended copy uses lower case.
- Label characteristics determined by illumination level, color.
- Labels easily, accurately read at operational reading distance, vibration, light levels, environments.
- Labels are sharp with high or color contrast.
- With illumination above 1 ft-c: black letters, light background.
- Dark adaptations letters visible, do not interfere with night vision.
- Chart reading: FIG 6.1.3.

- Label characteristics: accuracy required; time available; distance; light level; color; criticality of function; consistency of design.
- Labels on production equipment are as durable as the equipment.
- Labels for prototype equipment easily affixed, altered, removed.
- Labels not covered by other units nor obscured by grease, dirt.
- Markings, tags are as permanent, washable as equipment.
- Roman numerals avoided.
- Vertical labels used only when labels are not critical for personnel safety, performance.
- Electrical receptacles marked with voltage, phase, frequency.
- Pipe, hose, tube lines clearly labeled as to contents, pressure, temperature, hazards.
- Warning placards illuminated.
- Placards adjacent to hazards.

- Abbreviations are standard (MIL-STD-12); new OK if obvious.
- Trade names, irrelevant info do not appear on labeling.
- Labels concise; min redundancy.
- Abstract symbol only if meaningful.
- Words familiar to user.
- Hand grasp areas identified.

## 1.4 HANDLES

The specification of inherent devices used to grasp, hold, grip or lift an item for lifting, moving, the doing of work, handling, knobs, projections, struts, etc. Involves rounded or non slip surface when used for handling. Check also for the lack of handles.

- Handles on channels, consoles are recessed.
- Handles, grasp areas are located relative to the CG.
- Hinged, fold-out handles have a stop position; one hand operation.
- Handles located so that lifting is at min distance from body.
- Lift points on large items are equidistant from the CG.
- Handles provided to remove cover.
- Handles are on front of an item if it is pulled from a rack.
- Bar, T-bar, J-bar, recessed handles: FIG 1.B.1.1.
- Two handles min, or one handle/grasp area for units 10 lbs. or more.
- Hand shaped handle used on item carried frequently or for long periods.
- Handles reachable by 5th% user wearing bulky, restrictive clothing.

- Weight limits for one man lift: FIG 1.B.1.1; if shape is convenient, handles are provided, lift is not repeated, items are not carried.
- Handle, grasp area force limits: FIG 6.C.1.
- Two-man lift values are twice one-man lift only if item configuration convenient; neither man exceeds one-man limit.

- Handles have at least 2h" clearance from obstructions.
- Straps, buckles do not interfere with operation of item.

- Handles color coded to distinguish from similar shaped items.
- Handles are visible from the grasping, lifting position.

- Hand grips have nonslip surface.
- Removable, carried units provided with handles, other suitable means for grasping, handling, carrying.
- Handles do not interfere with operating or maintaining item.
- Carried item will ride clear of legs of personnel.
- Handles, lugs, push bars are permanent parts of equipment case.

- Handle/grasp surfaces are not thermally/electrically conductive.
- Insulated handles used on hot items.
- Non-recessed handles do not injure personnel, entangle clothing, damage equipment.
- Edges rounded; attaching screws recessed.

- Items exceeding one man lift (FIG 1.B.1.1) are labeled with weight, lift limits.
- Hand grasp areas identified.

## 2 ACCESSORIES

Components used for locking, unlatching, securing, etc. of equipment. Includes covers, boxes, bags, and covers that are not part of the item but are used for transport. Carrying cases and storage boxes specifically designed for the item, or multiples of the item, and are part of the item configuration.

- Cases lift from seats rather than units lift from cases.
- For cross country ops items secured in storage boxes or restrained by straps, brackets.
- Storage mail slots for ration.
- Tools for opening are built in or attached to containers.
- Tools, devices that are carried fold, roll up so they require minimum carrying space.
- Stowed items accessible by 5-95th% personnel: FIG 2.B.1.2.
- Small packages are sized for pockets, are relatively flat.

- Catches, fasteners lock, unlock easily.
- Flaps, tabs, etc. are large enough for full hand or finger grasp & force application.

- Cases are enough larger than units they cover to prevent damage when case is removed, replaced.
- Light fitting stowage avoided.
- Containers allow for full hand, finger clearance when using opening tool.
- Flapless hand clearance provided: FIG 2.B.1.1.

- It is obvious when a cover is in place but not secured.
- Identification of package contents clearly visible.
- Tools, grasp points for opening are clearly visible, identifiable.

- Accessibility of stowed equipment reflects its function, use.
- Fully open, closed state obvious.
- Material remaining is easily determined.
- Sealed cans have integral opener device, strap, tab.
- Stowage boxes are part of vehicle, rather than attachments.
- Special opening tools avoided.

- Edges, corners on covers, cases are rounded, otherwise finished to prevent personnel injury.
- Glass containers avoided for field usage.

- Orientation of a unit within its case is obvious or labeled.
- Labels, markings tell how to open, remove, position covers, cases.
- Instructions on opening a cover are permanently displayed if opening is not obvious.

## 3 CONTAINERS

Those receptacles used for the storage, transport, and distribution of equipment, including the use of containers, including first aid kits, and containers for removing moisture.

- Storing, rotating, and unit units rotate the full distance, remain in place without hand support.

- Gross (handling) dimensions based on 95th% (5th% user): FIG 2.B.1.2.
- Hand, unit, finger access: FIG 1.B.1.1.
- Caps are large enough to be handled with gloves.
- Regimens to open, work within access limits are obvious size.
- Flapless hand clearance provided: FIG 2.B.1.1.

- Replaceable items are not placed in a manner which makes them difficult to remove.
- Small covers hinge at bottom, open down.
- Caps latch, require positive force to open, is within capacity of 5th% user: FIG 6.C.1.
- Caps tighten CW, loosen CCW.

- Openings are large enough to permit required operations.
- Allowance is made for gloved hand or externally located access.
- Containers opening large enough to allow full entry, passage of measuring devices.

- Visual access cover preference: none, transparent, break-resistant glass, quick opening metal.
- It is obvious when a cover is in place but not secured.
- Visual access only for components requiring a visual check.
- Instructions visible when access cover is open.
- Openings allow visibility of internal components while operator performs tasks.

- Access covers are equipped with grasp means for opening.
- Physical access cover preference: none, sliding, hinged, quick opening.
- Captive fasteners used when periodic removal is required.
- Cover fasteners self lock for closing with double snap.
- Replaceable caps captive.
- Sliding doors, caps lock positively.

- Edges, corners on covers, cases are rounded to prevent injury.
- Hazardous voltage behind access cover is demarcated with an interlock attached to cover.
- Access over dangerous mechanical, electrical component has an internal light, warning on door.
- Pressurized caps are captive.

- Cover opening method is obvious or instructions are displayed on outside of cover.
- Accesses are labeled with warning signs advertising of hazards within, precautions needed.
- Labels, instructions are properly oriented when cover, case, door is open.
- Labels indicate how service equipment is oriented, connected.

## 4 DISPLAYS

Those visual displays which provide information to the operator, including the use of displays, including first aid kits, and containers for removing moisture.

- Displays are visible from the operator's position.
- Displays are visible from the operator's position.
- Displays are visible from the operator's position.

- Display viewing post: Minimum viewing post: 45° min (operator's position).
- Display viewing post: Minimum viewing post: 45° min (operator's position).
- Display viewing post: Minimum viewing post: 45° min (operator's position).

- Containers of unit units, clearance with body.

- Display frame to line: 45° min (operator's position).
- Other relevant items.

- Display presentation: text with that of the operator's position.
- Display presentation: text with that of the operator's position.
- Display presentation: text with that of the operator's position.



COVERS, CAPS

20 MEASURES

an item that allows  
straps, connectors,  
fasteners, visual  
aids or components  
and inserting or  
access covering, it

hinged units open,  
distance, remain in  
support.

dimensions based on  
FIG 25.B.1-7.  
access: FIG  
ough to be handled  
see, work within  
opening size.  
FIG 25.B.1-9.

s are not placed in  
makes them diffi-  
at bottom, open  
fires positive force  
capability of 30%  
loosen CCW.

e enough to permit  
te for gloved hand  
ted access.  
g large enough to  
possess of measur-

cover, preference  
t, break-resistant  
g metal.  
a cover is in place

y for components  
check.  
- when access cov-  
sibility of internal  
operator performs

we equipped with  
ening.  
cover, preference  
ed, quick-opening  
s used when pe-  
repaired.  
ell lock for closing  
captive.  
; lock positively.

s covers, cases use  
tality.  
ge behind access  
ized with an inter-  
over.  
erous mechanical,  
ent has an internal  
door.  
are captive.

ethod is obvious or  
isplayed on outside  
uted with warning  
of hazards within,  
s.  
rs are properly ori-  
er, case, door is  
ow service equip-  
connected.

Displays are located so they can be  
read to the required accuracy.  
Display arrangement is consistent  
from one application to another.  
Measuring marks or opac-  
containers are placed inside.

Display viewing distance 13-28".  
Minimum number of measuring de-  
vices used.  
Container cup useable as standard or  
emergency measuring device for  
field use.  
Item container used for measuring  
where possible.  
Measurement marks raised.

- Design Requirements (MIL-STD-1472)
- User-Computer Interface Data (MIL-STD-1472C)
- Guidance Data (MIL-HDBK-759, Etc.)

Containers allow for full hand, finger, clearance when using opening tool.

Display face to line of sight exceeds 65°; min parallax, reflection.  
Other reflection minimized.

Display precision, response is consistent with that of system.  
Scales: linear, start at 0, use whole numbers, 2 pointers max, numerals oriented upright.  
Field items are non-corrosive, easily cleaned or disposed.

Information limited to that necessary to take action.  
Info is directly usable.  
Specified measuring amounts are consistent with measuring device.  
Measures clearly detailed.  
For group use: multiple of food components, general formula for computation given.







## MAINTAINABILITY

### VEHICLES

The conditions applicable to this class includes:

1. User conditions - body size, clothing and encumbrances, technician skills;
2. Environmental conditions - weather, temperature, noise, vibration, altitude and illumination levels;
3. Operational conditions - use conditions (different types of failures to be detected, isolated and repaired, and different work pieces) and time critical operations (quick fix, rapid troubleshooting, etc.).

| PERFORM CORRECTIVE MAINTENANCE   |   |  |  |
|----------------------------------|---|--|--|
| APPLY                            | DETECT/ISOLATE FAULTS   | PREPARE FOR REPAIR   | REPAIR   |
| design of the<br>1. resupply ac- | <p><b>PURPOSE:</b> Evaluate the design of the item to enable the technician to detect faults and perform troubleshooting.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Identify failure.</p> <p>Identify affected system.</p> <p>Identify faulty component.</p> <p>Identify faulty part.</p> <p>Read displays.</p> <p>Use test sets.</p> | <p><b>PURPOSE:</b> Evaluate the design of the item for completion of system preparation activities.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Configure system.</p> <p>Configure component.</p> <p>Configure part.</p> <p>Select tools.</p> <p>Configure support systems.</p> <p>Remove component.</p> <p>Disassemble component.</p> <p>Inspect parts.</p> | <p><b>PURPOSE:</b> Evaluate the design of the item to enable the technician to perform repair activities.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Perform electrical repair.</p> <p>Perform mechanical repair.</p> <p>Perform hydraulic repair.</p> <p>Remove/replace parts.</p> <p>Repair parts.</p> <p>Conduct tests.</p> <p>Verify readiness. (See "Inspect/Check-out")</p> |

#### DETAILED DESIGN CONSIDERATIONS

| Replacable<br>Items<br>(21) | Displays<br>(8) | Test<br>Elements<br>Tools<br>(18) | Workpiece<br>(19) | Lines<br>Hoses<br>Cables<br>(12) | Fasteners<br>Connectors<br>(13) | Workpiece<br>(19) | Replacable<br>Items<br>(21) |
|-----------------------------|-----------------|-----------------------------------|-------------------|----------------------------------|---------------------------------|-------------------|-----------------------------|
| A                           | A               | A                                 | A                 | A                                | A                               | A                 | A                           |
| B                           | B               | B                                 | B                 | B                                | B                               | B                 | B                           |
| C                           |                 | C                                 | C                 | C                                | C                               | C                 | C                           |
| D                           |                 | D                                 | D                 | D                                | D                               | D                 | D                           |
| E                           | E               | E                                 | E                 | E                                | E                               | E                 | E                           |
| F                           | F               | F                                 | F                 | F                                | F                               | F                 | F                           |
| G                           | G               | G                                 | G                 | G                                | G                               | G                 | G                           |
| H                           | H               | H                                 | H                 | H                                | H                               | H                 | H                           |



| 1. INTRODUCTION  | 2. TABLES, DATA AND DIAGRAMS  | 3. EXPLANATION OF SYMBOLS  | 4. FIGURES   | 5. APPENDICES  | 6. INDEX   |
|--|---|--|--|--|--|
| <p><b>A. Purpose</b></p> <p>This document is intended to provide a standard for the design and development of technical documents. It is intended to be used by all personnel involved in the design and development of technical documents.</p> <p><b>B. Scope</b></p> <p>This document applies to all technical documents, including but not limited to, reports, manuals, and drawings. It does not apply to marketing materials or other non-technical documents.</p> <p><b>C. Definitions</b></p> <p>The following definitions apply to the terms used in this document:</p> <ul style="list-style-type: none"> <li><b>Technical Document:</b> A document that contains technical information, such as data, diagrams, and tables.</li> <li><b>Design:</b> The process of creating a plan or drawing for a technical document.</li> <li><b>Development:</b> The process of creating a technical document from a design.</li> </ul> <p><b>D. References</b></p> <p>The following references are used in this document:</p> <ul style="list-style-type: none"> <li>MIL-STD-1472</li> <li>MIL-STD-1473</li> <li>MIL-STD-1474</li> </ul> <p><b>E. Abbreviations</b></p> <p>The following abbreviations are used in this document:</p> <ul style="list-style-type: none"> <li>Fig. - Figure</li> <li>Tab. - Table</li> <li>Diag. - Diagram</li> </ul> <p><b>F. Symbols</b></p> <p>The following symbols are used in this document:</p> <ul style="list-style-type: none"> <li>Fig. - Figure</li> <li>Tab. - Table</li> <li>Diag. - Diagram</li> </ul> <p><b>G. Tables</b></p> <p>The following tables are used in this document:</p> <ul style="list-style-type: none"> <li>Table 1 - Table of Contents</li> <li>Table 2 - List of Figures</li> <li>Table 3 - List of Tables</li> </ul> <p><b>H. Diagrams</b></p> <p>The following diagrams are used in this document:</p> <ul style="list-style-type: none"> <li>Diagram 1 - Flowchart of the Design Process</li> <li>Diagram 2 - Flowchart of the Development Process</li> </ul> | <p><b>1. TABLES, DATA AND DIAGRAMS</b></p> <p>Provide technical information in the form of tables, data, and diagrams. Use standard symbols and abbreviations. Provide a clear and concise explanation of the information.</p> <ul style="list-style-type: none"> <li>Tables should be clearly labeled and easy to read.</li> <li>Data should be presented in a clear and concise manner.</li> <li>Diagrams should be clearly labeled and easy to read.</li> </ul> <p><b>2. TABLES, DATA AND DIAGRAMS</b></p> <p>Provide technical information in the form of tables, data, and diagrams. Use standard symbols and abbreviations. Provide a clear and concise explanation of the information.</p> <ul style="list-style-type: none"> <li>Tables should be clearly labeled and easy to read.</li> <li>Data should be presented in a clear and concise manner.</li> <li>Diagrams should be clearly labeled and easy to read.</li> </ul> | <p><b>3. EXPLANATION OF SYMBOLS</b></p> <p>Explain the meaning of the symbols used in the technical documents. Provide a clear and concise explanation of the symbols.</p> <ul style="list-style-type: none"> <li>Explain the meaning of the symbols used in the technical documents.</li> <li>Provide a clear and concise explanation of the symbols.</li> </ul> <p><b>4. FIGURES</b></p> <p>Explain the meaning of the figures used in the technical documents. Provide a clear and concise explanation of the figures.</p> <ul style="list-style-type: none"> <li>Explain the meaning of the figures used in the technical documents.</li> <li>Provide a clear and concise explanation of the figures.</li> </ul> <p><b>5. APPENDICES</b></p> <p>Provide additional information that is not included in the main body of the technical document. Provide a clear and concise explanation of the information.</p> <ul style="list-style-type: none"> <li>Provide additional information that is not included in the main body of the technical document.</li> <li>Provide a clear and concise explanation of the information.</li> </ul> | <p><b>6. INDEX</b></p> <p>Provide a list of the topics covered in the technical document. Provide a clear and concise explanation of the topics.</p> <ul style="list-style-type: none"> <li>Provide a list of the topics covered in the technical document.</li> <li>Provide a clear and concise explanation of the topics.</li> </ul> <p><b>7. APPENDICES</b></p> <p>Provide additional information that is not included in the main body of the technical document. Provide a clear and concise explanation of the information.</p> <ul style="list-style-type: none"> <li>Provide additional information that is not included in the main body of the technical document.</li> <li>Provide a clear and concise explanation of the information.</li> </ul> | <p><b>8. INDEX</b></p> <p>Provide a list of the topics covered in the technical document. Provide a clear and concise explanation of the topics.</p> <ul style="list-style-type: none"> <li>Provide a list of the topics covered in the technical document.</li> <li>Provide a clear and concise explanation of the topics.</li> </ul> <p><b>9. APPENDICES</b></p> <p>Provide additional information that is not included in the main body of the technical document. Provide a clear and concise explanation of the information.</p> <ul style="list-style-type: none"> <li>Provide additional information that is not included in the main body of the technical document.</li> <li>Provide a clear and concise explanation of the information.</li> </ul> | <p><b>10. INDEX</b></p> <p>Provide a list of the topics covered in the technical document. Provide a clear and concise explanation of the topics.</p> <ul style="list-style-type: none"> <li>Provide a list of the topics covered in the technical document.</li> <li>Provide a clear and concise explanation of the topics.</li> </ul> <p><b>11. APPENDICES</b></p> <p>Provide additional information that is not included in the main body of the technical document. Provide a clear and concise explanation of the information.</p> <ul style="list-style-type: none"> <li>Provide additional information that is not included in the main body of the technical document.</li> <li>Provide a clear and concise explanation of the information.</li> </ul> |



[illegible]



**TEST ITEM CLASS II**

The conditions appl

1. User conditions - be
2. Environmental con  
and illumination lev
3. Operational condit  
detected, isolated (operations (quick fi

| PERFORM PREVENTIVE MAINTENANCE   |  |  |  |
|--|--|--|--|
| ADJUST/ALIGN   | SERVICE  | REMOVE/REPLACE   |  |
| <p><b>PURPOSE:</b> Evaluate the design of the item to facilitate adjustment and alignment.</p> <p><b>MAN/ITEM TASKS</b></p> <ul style="list-style-type: none"> <li>Identify requirements.</li> <li>Consult publications.</li> <li>Read labels.</li> <li>Assemble tools.</li> <li>Access test points.</li> <li>Gain access to parts.</li> <li>Align/adjust parts.</li> <li>Use controls and tools.</li> </ul> | <p><b>PURPOSE:</b> Evaluate the item design for ease of lubrication, filling, draining, and cleaning.</p> <p><b>MAN/ITEM TASKS</b></p> <ul style="list-style-type: none"> <li>Remove covers.</li> <li>Access service points/drains/parts.</li> <li>Lubricate item.</li> <li>Fill with fluid.</li> <li>Read displays.</li> <li>Disassemble.</li> <li>Clean components.</li> <li>Tighten parts.</li> <li>Disconnect lines.</li> <li>Blow/clean lines.</li> </ul> | <p><b>PURPOSE:</b> Evaluate the design of the item for removal and replacement of parts and units.</p> <p><b>MAN/ITEM TASKS</b></p> <ul style="list-style-type: none"> <li>Handle expendables/replaceables.</li> <li>Prepare system for module removal.</li> <li>Prepare module for removal.</li> <li>Prepare workspace for module.</li> <li>Stow module.</li> <li>Install fresh module.</li> <li>Replace module.</li> </ul> | <p><b>PURPOSE:</b> Evaluate the design of the item to facilitate detection and isolation of faults.</p> <p><b>MAN/ITEM TASKS</b></p> <ul style="list-style-type: none"> <li>Detect faults.</li> <li>Access components.</li> <li>Acquire test equipment.</li> <li>Interpret test results.</li> <li>Consult manuals.</li> <li>Isolate faults.</li> </ul> |

[illegible]



## WEAPONS

1. User conditions - body size, clothing and encumbrances, technician skills;
2. Environmental conditions - weather, temperature, noise, vibration, climate and illumination levels;
3. Operational conditions - use conditions (different types of failures to be detected, isolated and repaired, and different work pieces) and time critical operations (quick fix, rapid troubleshooting, etc.).

## DETAILED DESIGN CONSIDERATIONS

[illegible]







| 12   | 13   | 18  | 19  | 21  |
|--|--|---|---|---|
| <b>WIRING, CABLES</b>  | <b>FASTENERS, CONNECTORS</b>   | <b>TEST ELEMENTS, TOOLS</b>   | <b>ACCESS, COVERS, CAPS</b>   | <b>REPLACEABLE ITEMS</b>  |
| <p>Wiring, cables, wires, lines, hoses, pipes, vents, etc., that pass from or to the test item.</p> <p>Plugs, sockets, quick-disconnect fittings, etc., for use in transport as well as for stationary use.</p> <p>Includes fastener and connector alignment and locking devices such as lock pins, safety wires, pins, nuts, electrical plugs, and fittings.</p> <p>Common and special tools and test instruments for assembly, adjustment, calibration and alignment.</p> <p>Includes special maintenance equipment such as lubrication points, pouring spouts, filter tubes and nozzles.</p> <p>Three openings in an item that allow manipulation of controls, conversion and disconnection of fasteners, visual checking of displays or components utilizing test points, and inserting or removing materials.</p> <p>Includes the access covering, if any.</p> <p>Reservoir fill points and drains for lubricants, hydraulic fluids, other liquids, air, gases, etc.</p> <p>Filters for fuel, oil, air.</p> <p>Includes vacuum tubes, electronic modules and low MTBF parts.</p>  | <p>Securing devices used to assemble, package or hold an item in place.</p> <p>Catchers, hooks, screws, bolts, nuts, washers, both quick release and tool operated.</p> <p>Includes fastener and connector alignment and locking devices such as lock pins, safety wires, pins, nuts, electrical plugs, and fittings.</p> <p>Common and special tools and test instruments for assembly, adjustment, calibration and alignment.</p> <p>Includes special maintenance equipment such as lubrication points, pouring spouts, filter tubes and nozzles.</p> <p>Three openings in an item that allow manipulation of controls, conversion and disconnection of fasteners, visual checking of displays or components utilizing test points, and inserting or removing materials.</p> <p>Includes the access covering, if any.</p> <p>Reservoir fill points and drains for lubricants, hydraulic fluids, other liquids, air, gases, etc.</p> <p>Filters for fuel, oil, air.</p> <p>Includes vacuum tubes, electronic modules and low MTBF parts.</p>  | <p>Common and special tools and test instruments for assembly, adjustment, calibration and alignment.</p> <p>Includes special maintenance equipment such as lubrication points, pouring spouts, filter tubes and nozzles.</p> <p>Three openings in an item that allow manipulation of controls, conversion and disconnection of fasteners, visual checking of displays or components utilizing test points, and inserting or removing materials.</p> <p>Includes the access covering, if any.</p> <p>Reservoir fill points and drains for lubricants, hydraulic fluids, other liquids, air, gases, etc.</p> <p>Filters for fuel, oil, air.</p> <p>Includes vacuum tubes, electronic modules and low MTBF parts.</p>   | <p>Three openings in an item that allow manipulation of controls, conversion and disconnection of fasteners, visual checking of displays or components utilizing test points, and inserting or removing materials.</p> <p>Includes the access covering, if any.</p> <p>Reservoir fill points and drains for lubricants, hydraulic fluids, other liquids, air, gases, etc.</p> <p>Filters for fuel, oil, air.</p> <p>Includes vacuum tubes, electronic modules and low MTBF parts.</p>   | <p>Reservoir fill points and drains for lubricants, hydraulic fluids, other liquids, air, gases, etc.</p> <p>Filters for fuel, oil, air.</p> <p>Includes vacuum tubes, electronic modules and low MTBF parts.</p>   |
| <p>Light standing, 30 min.</p> <p>Design allows equipment communication.</p> <p>Wiring harness are 29-11" long.</p> <p>Location identified, tested, installed with elements in mind.</p> <p>Integral with work test points, etc.</p> <p>any exceeds 1 ft. min.</p> <p>routing space: 30x16"</p> <p>FIG 10.B.1-3.</p> <p>Dimensions based on fully equipped user utility: FIG 25.B.8, 30x16" 5-95th%</p> <p>ment: 15-21" in 1"</p> <p>add 4" min.</p> <p>of hose to lift will restrict entry, ram station.</p> <p>er: 14" had min. for space 4" min. with drawer at 45-15, 10" each use other side min. 14" had min. for heavy use equipment.</p> <p>FIG 10.C.1.</p> <p>space for use is 11 1/2", heavy clothing, reached upon.</p> <p>on provided.</p> <p>rometrically: FIG 10.L.3.</p> <p>ment does not detectiveness.</p> <p>FIG 25.B.8.</p> <p>ation limiting X, Y, Z, 1.</p> <p>on unit that wand.</p> <p>not not exposed to 15-450° optimal.</p> <p>ers, limits, toxicity: 10.L.3.</p> <p>limits: FIG 10.G.3.</p> <p>ation within twice next: FIG 10.F.9.</p> <p>device provided, replace is free from instructions.</p> <p>did if temp exceeds 1 handled.</p> <p>on moving parts, 3 minimized.</p> <p>1 simple.</p> <p>le storage for use, etc.</p> <p>ork surfaces to support.</p> <p>scars adjacent to test to user.</p> <p>special equipment, locally identified, dates detailed.</p> <p>include warnings that hazards of 35.</p> | <p>Conductors are bound into cables, held by lacing tape.</p> <p>Long conductors, cables internal to equipment are clamped to chassis.</p> <p>Test cables terminating on panel do not interfere with controls, displays.</p> <p>Cables are routed so as to be accessible for maintenance, repair.</p> <p>Reels, reel carts provided to handle large, heavy, long lines, cables.</p> <p>Cable clamps spaced every 12".</p> <p>Cable attachment parts reachable by user in bulky clothing.</p> <p>Cables are long enough to allow functioning unit to be checked conveniently or extension cables p. 2-10.</p> <p>Electrical plug size, shape coded.</p> <p>Line fittings standardized so lines that differ in content are not interchangeable.</p> <p>Cables are size, shape coded for similar components.</p> <p>Line, cable attachment parts reachable by user in bulky clothing.</p> <p>Hand operation or common tools used to tighten, loosen.</p> <p>Tighten CW; loosen CCW.</p> <p>Adequate space provided to handle cables, lines, hoses.</p> <p>Clearance between cables &amp; controls: 3" min.</p> <p>Cable, line, hose connectors operable by user wearing arctic mittens.</p> <p>ID tapes visible at line ends, intervals; near valves, vents, etc.</p> <p>Bands, tags, paint are adjacent to valves, regulators, clean outs, flow checks, clean outs, branch lines, at intervals &amp; where line goes thru walls, floors.</p> <p>Line, hose, cable color contrasts with background.</p> <p>Manner of connection, disconnection is obvious.</p> <p>Number of in's, outputs are minimized by grouping functions.</p> <p>Cables are reachable, visible.</p> <p>Irregular, fragile, outward extensions removed, cable for handling.</p> <p>Cables are not pinched by doors, latches, walked on, used as handholds, bent, twisted repeatedly.</p> <p>Cables routed thru holes are protected by grommets, etc.</p> <p>Protective caps, covers, inserts are available as necessary.</p> <p>High pressure lines have retaining chain attached to line and source.</p> <p>Electric wiring routed away from lines carrying O<sub>2</sub> (flammable fluids).</p> <p>Multiple conductors color coded.</p> <p>Lines labeled as to function, sub-function, hazard, flow: FIG 12.F.1.</p> <p>ID tapes encircle the line.</p> <p>Cables labeled as to which equipment, connector they belong.</p> <p>Line color (symbol) (hazard) color: FIG 12.F.2 (12.F.3) (12.F.4).</p> <p>Dangerous voltage placarded.</p> <p>Hydraulic, electric: FIG 12.F.5-6.</p> <p>Receptacles marked as to voltage, phase, frequency.</p> <p>Connecting plugs, receptacles identified by color, size.</p> <p>Plugs, receptacles have stripes, arrows, etc to show aligning pin position.</p> <p>Manner of connection obvious.</p> <p>Non-standard operating direction is clearly marked.</p> <p>Plug, receptacle identification: FIG 13.F.1.</p> | <p>Cables terminating on control, display panels do not interfere with controls, displays.</p> <p>External (internal) test points are of the jack (standard) terminal design.</p> <p>Test points reflect the sequence for sequential testing.</p> <p>Test points for adjustment are close to the controls, displays used.</p> <p>Special tools required for adjustment are with equipment.</p> <p>Test points, built-in meters used to make fastened unit, module.</p> <p>Limiting body dimensions based on 5th% user for reaching test points: FIG 25.B.1.</p> <p>Sensitive adjustment points have a hand, arm rest nearby if vibration is present during adjustment.</p> <p>Cables are long enough to check unit in place.</p> <p>Braces held hinged as in working position.</p> <p>Test equipment fits the hand or has handle, hand support.</p> <p>Calibration, adjustment controls located close to prevent damage.</p> <p>Built-in aligning devices, other aids are used for positioning optical assemblies within instrument.</p> <p>Access to unit maintained by one technician does not require removal of parts maintained by another.</p> <p>Quick-release removal for optics.</p> <p>Stands, casters (wheels), hoist-lifting is provided for equipment exceeding 30 lb (70 lb).</p> <p>Adequate storage provided in portable test equipment case, lid to contain leads, probes, spares, manuals, tools.</p> <p>Large parts are not mounted to deny access to smaller ones.</p> <p>Sufficient space provided for test equipment, tool use without difficulty, hazard.</p> <p>Optics purging, charging fittings are accessible.</p> <p>Sensitive adjustment points, guarded against accidental disturbance.</p> <p>Indication of equipment power failure is provided.</p> <p>Test, adjustment, check point and labels, connectors, labels are accessible, visible during maintenance.</p> <p>Positive indication of open fuse.</p> <p>Non-visible screwdriver adjustments have mechanical shut guide.</p> <p>Test equipment has panel lighting.</p> <p>Enough test points are provided to prevent removing sub-assemblies.</p> <p>Special tool use minimized.</p> <p>Items frequently removed for test are mounted on rollout racks, slides, hinges.</p> <p>Knobs preferred to screwdriver for frequent adjustment.</p> <p>Tools provided with rings, eyes compatible with quick-release snaps, hooks on tool belts.</p> <p>Test equipment is not overly complicated, difficult to use.</p> <p>Electrical potentials over 300V are stepped down for test points.</p> <p>Electrical hand-held tools have 3-wire power with ground or are double insulated.</p> <p>Exposed surfaces of electrical hand-held tools are non-conducting or grounded.</p> <p>Contacts, terminals are shielded with suitable protective measures to prevent accidental contact.</p> <p>Test points permanently labeled, color coded.</p> <p>Operating instructions for portable test equipment affixed to unit, lid or compartment.</p> <p>Calibration reminder included with test instructions.</p> <p>Contacts, terminals, etc over 500V are clearly labeled.</p> <p>Reference scale is provided for control adjustment.</p> <p>A simple check shows when equipment is out of calibration.</p> | <p>Sliding, rotating, hinged units open, rotate their full distance, remain in place without hand support.</p> <p>Cover mounting holes large enough to permit attaching screws to pass without perfect alignment.</p> <p>Covers not completely removable are self supporting.</p> <p>Access large enough to insert arm, hand, tools, test equipment.</p> <p>Rubber stripping, welding material located so user will not damage it.</p> <p>Gross (limiting) dimensions based on 95th% (5th%) user: FIG 25.B.1-7.</p> <p>Hand, arm, finger access: FIG 19.B.1.</p> <p>Rectangular (round (oval)) hatch dimensions: FIG 4.B.1 (30" dial (17"x28")).</p> <p>Caps are large enough to be handled with gloves.</p> <p>Requirements to see, work within access determine opening size.</p> <p>Clothed arctic user: FIG 25.B.8.</p> <p>Structural members do not prevent access to components.</p> <p>Replaceable items are not placed in a manner which makes them difficult to remove.</p> <p>Small covers hinge at bottom, open down.</p> <p>Cover latch requires positive force to open, is within capability or 5th% user: FIG 6.C.1.</p> <p>Caps tighten CW, loosen CCW.</p> <p>One man can lift cover.</p> <p>Bullheads, brackets don't interfere with opening, removing covers where work is done.</p> <p>Openings are large enough to permit required operations.</p> <p>Allowance is made for gloved hand in externally located access.</p> <p>Open covers do not interfere with controls, displays.</p> <p>Visual access cover preference: none, transparent, break-resistant glass, quick opening metal.</p> <p>It is obvious when a cover is in place but not obvious when cover is open.</p> <p>Visual access only for components requiring a visual check.</p> <p>Instructions visible when access cover is open.</p> <p>Openings allow visibility of internal components while operator performs tests.</p> <p>Access provided if frequent maintenance requires removing case, cover, dismantling components.</p> <p>Access covers are equipped with grasp areas for opening.</p> <p>Physical access cover preference: none, sliding, hinged, quick-opening.</p> <p>Captive fasteners used when periodic removal is required.</p> <p>Cover fasteners self lock for closing with audible snap.</p> <p>Edges, corners on covers, cases are rounded to prevent injury.</p> <p>Hazardous voltage behind access cover is de-energized with an interlock attached to cover.</p> <p>Access over dangerous mechanical, electrical component has an internal light, warning on door.</p> <p>Pressurized caps are captive.</p> <p>Cover opening method is obvious or instructions are displayed on outside of cover.</p> <p>Accesses are labeled with warning sign advertising of hazards within, precautions needed.</p> <p>Labels indicate function of units behind enclosure, access.</p> <p>Labels, instructions are properly oriented when cover, case, door is open.</p> <p>Labels indicate how service equipment is oriented, connected.</p> | <p>Don't need to disassemble to kube.</p> <p>Replaceable units remain "open" without support; well laid out; readily accessible.</p> <p>Fuses easily accessible.</p> <p>Parts mounted on one plane.</p> <p>Legend screens, indicator covers cannot be interchanged.</p> <p>Similarly shaped items with different function have standard orientation throughout; easily identified; not interchangeable.</p> <p>Blind screwdriver adjustments have mechanical guides.</p> <p>Sensitive adjustments guarded; hand support provided.</p> <p>Weighted limits for one man lift: FIG 14.C.1; if shape is convenient, handles are provided, lift is not repeated, item is not carried.</p> <p>Horizontal push, pull force limits: FIG 14.C.2.</p> <p>Units that are pulled out of item are mounted on rollout racks, slides, hinges.</p> <p>Simple indicator lights have clearance for easy bulb replacement.</p> <p>Large parts do not prevent access to other parts.</p> <p>Check, adjustment, test points; connectors, labels are accessible during maintenance.</p> <p>Enough clearance is provided to replace parts without contacting hardware.</p> <p>Fill points, drains reachable by 5th% user in restrictive, clothing.</p> <p>Timing marks, other adjustable indicators minimize parallax, are readily visible.</p> <p>Reference scales visible.</p> <p>Components visible from maintenance position.</p> <p>Maintenance points contrast with background.</p> <p>Lighted indicators incorporate filament redundancy/fail lamps.</p> <p>Faulty equipment is easily detected, quickly removed, repaired using standard parts, modules.</p> <p>Delicate parts are protected.</p> <p>Lamps replaceable with power on.</p> <p>Critical, low MTBF parts are the most accessible.</p> <p>Common hand tools for field units.</p> <p>Group areas on carried units.</p> <p>Guide pins, rollout racks, interlocks, drawers, hinges, quick-disconnects aid removal, replacement.</p> <p>Interlocks indicator or alarm.</p> <p>Internal controls located near rotating parts, high volts, other hazards are shielded.</p> <p>Rollout racks: steps provided; CG does not overshift, topple item.</p> <p>Units can be accessed without danger from heat, moving parts, electricity, chemicals, radiation.</p> <p>External parts are grounded.</p> <p>Pressurized components have bleed valve.</p> <p>Parts, components, circuits, assemblies meaningfully labeled.</p> <p>Lube points labeled as to type, frequency.</p> <p>Items exceeding one man lift labeled with weight, limitation.</p> <p>Hoist, jacks, lift points; CG; "no step" weights labeled.</p> <p>Replaceable items coded, keyed.</p> <p>Fuses labeled, rated.</p> <p>Battery terminals marked "+", "-", hazardous conspicuously placarded.</p> <p>Grasp areas identified.</p> |



The conditions applicat

1. User conditions - body
2. Environmental conditions and illuminance levels;
3. Operational conditions detected, isolated and operations (quick fix, r

| PERFORM PREVENTIVE MAINTENANCE   |   |   |  |
|--|---|---|--|
| PERFORM ROUTINE SERVICING  | INSPECT/CHECKOUT  | REPLENISH/RESUPPLY  | DET  |
| <p>PURPOSE: Evaluate the design of the item for enabling the technician to perform routine servicing.</p> <p>MAN/ITEM TASKS</p> <ul style="list-style-type: none"> <li>Clean components.</li> <li>Tighten components.</li> <li>Adjust components.</li> <li>Align components.</li> <li>Calibrate components.</li> </ul> | <p>PURPOSE: Evaluate the design of the item in terms of technician performance and safety in conducting inspection and checkout.</p> <p>MAN/ITEM TASK</p> <ul style="list-style-type: none"> <li>Conduct walk around inspection.</li> <li>Conduct static checkout.</li> <li>Conduct dynamic checkout.</li> <li>Verify readiness.</li> </ul> | <p>PURPOSE: Evaluate the design of the item for replenishment and resupply activities.</p> <p>MAN/ITEM TASKS</p> <ul style="list-style-type: none"> <li>Remove/replace.</li> <li>Attach lines/hoses.</li> <li>Refill.</li> <li>Charge.</li> </ul> | <p>PURPOSE: Evaluate the design of the item to enable identification of faults and defects.</p> <p>MAN/ITEM TASKS</p> <ul style="list-style-type: none"> <li>Identify faults and defects.</li> <li>Identify abnormal conditions.</li> <li>Identify component wear.</li> <li>Identify component failure.</li> </ul> |

[illegible]



## MATERIEL HANDLERS

1. User conditions - body size, clothing and encumbrances, technician skills;
2. Environmental conditions - weather, temperature, noise, vibration, climate and illumination levels;
3. Operational conditions - use conditions (different types of failures to be detected, isolated and repaired, and different work pieces) and time critical operations (quick fix, rapid troubleshooting, etc.)

## DETAILED DESIGN CONSIDERATIONS

[illegible]



## 11 WATER AND AIR

### A. General

The design of the water and air systems must be such that the operator can easily identify the location of the water and air systems and the location of the water and air systems must be such that the operator can easily identify the location of the water and air systems.

### B. Water

The design of the water system must be such that the operator can easily identify the location of the water system and the location of the water system must be such that the operator can easily identify the location of the water system.

### C. Air

The design of the air system must be such that the operator can easily identify the location of the air system and the location of the air system must be such that the operator can easily identify the location of the air system.

### D. Water

The design of the water system must be such that the operator can easily identify the location of the water system and the location of the water system must be such that the operator can easily identify the location of the water system.

### E. Air

The design of the air system must be such that the operator can easily identify the location of the air system and the location of the air system must be such that the operator can easily identify the location of the air system.

### F. Water

The design of the water system must be such that the operator can easily identify the location of the water system and the location of the water system must be such that the operator can easily identify the location of the water system.

### G. Air

The design of the air system must be such that the operator can easily identify the location of the air system and the location of the air system must be such that the operator can easily identify the location of the air system.

### H. Water and Air

The design of the water and air systems must be such that the operator can easily identify the location of the water and air systems and the location of the water and air systems must be such that the operator can easily identify the location of the water and air systems.

Provide technical guidance in the form of written or pictorial instructions, illustrations and instruction cards. Give operator means of hazards. Give special guidance or instructions.

- Controls, displays, etc. are clearly, appropriately labeled except where obvious.
- Labels placed on or near items they identify.
- Do not cover other information.
- Labels are not a hindrance.
- Labels are not obscured by components on full-time surfaces on main chassis or main coverage by games not easily removed.
- Hinged door flapping upright in use.

- Character height determined by distance read, minimum FIG 10.1.1.
- Group label characters larger than those of controls, displays, which are larger than control, input or position characters each by 25% min.
- Letter, numeral styles FIG 10.2.4.
- Height width ratio: 5:32, 94% is 1 stroke width ratio 100% W/P h/w = 1 stroke width ratio 1 stroke width.
- Stroke width for block label characters on light (black) background FIG 10.2.4 of height.

- Spacing between characters (words) one stroke (character) width min.
- Line spacing 5 character height.
- Counter numeral low ratio: 1:1 (except 10 separation: 1.5 to h/w).
- Optical processing: all caps, stroke width 1:6 to 1:8; exceeds 15 minutes visual angle.
- Thumbwheel numeral low ratio: 1:32; h/w 1/4 stroke width internally (externally) illuminated: 10:1 (5:1).
- Abbreviations all caps, no periods.
- Extended caps lower case.
- Labels characteristics determined by illumination level, color.

- Labels easily, accurately read at operational reading distance, vibration, light levels, environments.
- Labels are sharp with high or color contrast.
- With illumination above 1 ft-C; block letters, light background.
- Dark adaptation: letters visible, do not interfere with night vision.
- Chart reading: FIG 10.2.3.
- Label characteristics accuracy: readability, time, availability, distance; light level, color, criticality of function, consistency of design.
- Labels for prototype equipment easily affixed, altered, removed.
- Labels not covered by other units not obscured by grease, dirt.
- Markings, tags are as permanent, washable as equipment.
- Labels are accessible, visible during maintenance.
- Plastic numerals avoided.
- Vertical labels used only when labels are not critical for personnel safety, performance.
- Electrical receptacles marked with voltage, phase, frequency.
- Pipe, hose, tube lines clearly labeled as to contents, pressure, temperature, hazards.
- Warning notices clear, directly characters 25% larger than any following instructions.
- Flammable adjacent to hazards.
- Circuit breakers labeled, accessible.
- Abbreviations are standard MIL-STD-129; new CW if follows.
- Trade names, relevant info do not appear on labeling.
- Labels concise, not redundant.
- Abstract symbol only if meaningful.
- Words familiar to user.
- Each cover, component, part labeled with visible, unambiguous number, number, symbol.
- Hand grip areas identified.
- Plastic info directly available min of obscuring information.

Components outside of cab or not in working position, involved in checkout and which are necessary for operation, lighting, fueling, etc. Tires, tracks, lights, batteries, vent pipes, test points, indicators, dip sticks, warning, starter cranks, pulleys, material handlers, etc.

- Drum valves: main number, readily accessible, reliable, hand operated.
- Filters accessible for inspection.
- Components requiring adjustment are readily accessible.
- Dial wheels show inner, outer lines tube checking, inflated.
- Source line can be checked, inflated when stopped.
- Special tools for operational adjustment mounted nearby.
- Fuel fill pipe outside cab, body.

- Gross limiting dimensions based on 95th % (5th % user: FIG 25.3.1-7).
- Drum pump valves same size or number of sizes minimized.
- Control vehicle fuel tanks which are over 100 gal. can be refueled at 50 gal/min (within 1 minute).
- Small parts, handled with one hand, are captive.

- Hinged access covers open down.
- Battery removable by one man.
- Secure line easily removed, replaced in carrier with vehicle fully loaded.
- Jacking operation feasible.

- Size of access large enough to insert hand, arm, body, test equipment.
- One large access preferred over two smaller ones.
- Safety chains do not damage, discontinue air, hydraulic, electrical cables.

- Size of access large enough to insert hand, arm, body, test equipment.
- One large access preferred over two smaller ones.
- Safety chains do not damage, discontinue air, hydraulic, electrical cables.

- Which operation observable from both within, cab locations.
- Timing marks, other indicators: minimum parallax, readily visible.
- Components which must be visible are color-coded, contrast with background.

- Trailer brake controls: within reach when parking, trailer manually not exposed to traffic.
- Minimum breakdown facilities easily installed, removed.
- Compressed air, vacuum brake reservoir his warning system.

- Fuel tank, lines are not within vehicle body.
- Bus exhaust pipe extends beyond rear body.
- Exhaust system located, protected so user cannot contact hot surfaces.
- Batteries well ventilated.
- Two separate ways to apply brakes.

- Battery terminals of different size, marked "H", "L".
- Weight capacity indicated on stands, lifts, baskets, racks.
- Dip sticks color coded.
- Special handling, assembly, operating procedures, precautions for cold weather or emergency items.
- Fuel tank capacity labeled.
- Tire pressure labeled.
- Fuel, oil, coolant, hydraulic fill points labeled: type, grade.

The area within which the user operates the equipment. Includes space for controls, displays, gauges, electronic devices, weapons and windows as well as standing areas, consoles and seats. Provides storage for excess clothing, personal gear, weapons and tools. Protects maintenance from adverse environment, when applicable.

- Work surface height: standing, 36 ± 1/2" seated, 29-31".
- Compartment design allows equipment sharing, good communication.
- Disk tops, writing tables are 29-31" above floor.
- Display reading location identified.
- Equipment designed, installed with workspace requirements in mind.
- Work stations integral with work piece, accesses, test points, etc.

- If van occupancy exceeds 1 hr: ceiling height 78" min.
- Lateral work (writing) space: 30x16" (24x16") w/d min.
- Standard console: FIG 10.3.1-3.
- Adjustable dimensions for 95th %.
- Vehicle operator's seat: FIG 10.3.1-3.
- Gross limiting dimensions based on 95th % (5th % fully equipped user: FIG 25.3.1-7, Arctic: FIG 25.3.1-7).

- Vertical seat adjustment: (5-21" in 1" increments).
- Seat adjusts fore, aft: 9" min.
- Operator does not have to lift self to adjust seat.
- Paddling does not restrict entry.

- Clonnet lock space: 4x4" h/d min.
- Console front floor space: 4" min.
- Equipment racks: front space 42" min; side space with dower weight minus (less) than 45 lb, 18" each side (18" one side 27" other side min).
- Side room: 25x20x18" h/d min.
- Allowances made for heavy clothing, protective equipment.
- Illumination: FIG 10.3.1.
- Sufficient clearance for use with gloves, arctic suits, heavy clothing, user space not encroached upon.

- Instrument reflection avoided.
- Workspace anthropometrics: FIG 10.3.1-2.
- Surface colors conform to MIL-STD-147.1.
- Reflections: FIG 10.3.3.
- Overhead clearance takes into account seat stiffening in cold.

- Acoustical environment does not degrade system effectiveness.
- Noise levels: FIG 10.3.2-8.
- Whole body vibration limits: X, Y, Z, time: FIG 10.3.9.
- Test stands are part of equipment.
- Handles are provided on units that are removed, carried.
- Arctic clothing must not expose to temp above 60°F; 35-45°F optimal.

- Exposure to gases, fumes, toxicity: see TABLE LIMIT VALUES.
- Noise duration limits: FIG 10.3.3.
- Whole body vibration within twice that for proficiency: FIG 10.3.9.
- Hazard alerting device provided.
- Maintenance workspace is free from injury causing obstructions.
- Equipment guarded if temp exceeds 140° F (120° F if handled).
- Guards provided on moving parts.
- Radiation hazards minimized.

- Adequate, suitable storage for manuals, workbooks, etc.
- Stands, have work surfaces to support manuals, etc.
- Elevators, hydraulic lifts have non load sign visible.
- Compressed, placards adjacent to equipment hazardous to user.
- Areas requiring special equipment, clothing are specifically identified.
- Emergency procedures detailed.
- Material safety data sheets include warnings on toxic, thermal hazards of batteries, exhaust gas.

- Multiple conductors color coded.
- Cables labeled as to which equipment, connector they belong.
- Lines labeled as to function, sub-function, hazard, flow: FIG 12.H.1.
- ID tapes encircle the line.
- ID tags, bands on cold, hot lines: stainless over 4" no near intakes.
- Line color symbol (thermal) code: FIG 12.H.2 (12.H.3) (12.H.4).
- Dangerous voltage placarded.
- Hydraulic, electric: FIG 12.H.5-6.

All cables, wires, lines, hoses, pipes, vents, etc. that pass from or to the test item. Plugs, sockets, quick-disconnect fittings for the above. Includes components for transport as well as for stationary use.

- Conductors are bound into cables, held by lacing tape.
- Long conductors, cables internal to equipment are clamped to chassis.
- Test cables terminating on panel do not interfere with controls, displays.
- Cables are routed so as to be accessible for maintenance, repair.
- Line, cable attachment parts reachable by user in bulky clothing.
- Heels, reel carts provided to handle large, heavy, long lines, cables.
- Covered space for cable storage.
- Cable clamps spaced every 12".

- Cables are long enough to allow functioning unit to be checked conveniently or extension cables provided.
- Electrical plugs size, shape coded.
- Line fittings standardized so lines that differ in content are not interchangeable.
- Cables are size, shape coded for similar components.

- Hand operation or common tools used to tighten, loosen.
- Tighten CW; loosen CCW.

- Adequate space provided to handle cables, lines, hoses.
- Clearance between cables & controls: 3" min.
- Cables, lines, hoses, connectors operable by user wearing arctic mittens.

- ID tapes visible at line ends, intervals; near valves, vents, etc.
- Bands, tags, paint are adjacent to valves, regulators, clean outs, flow checks, clean outs, branch lines, at intervals & where line goes thru walls, floors.
- Line, hose, cable color contrasts with background.
- Manner of connection, disconnection is obvious.

- Number of inputs, outputs are minimized by grouping functions.
- Cables are reachable, visible.
- Irregular, fragile, awkward extensions removable for handling.
- Cables are not: pinched by doors, lids; walked on, used as handholds; bent, twisted repeatedly.
- Cables routed thru holes are protected by grommets, etc.
- Protective caps, covers, inserts are available as necessary.

- High pressure lines have retaining chain attached to line and source.
- Automatic shutoffs on fuel service equipment to prevent overflow, spillage.
- Electric wiring routed away from lines carrying O<sub>2</sub>, flammable fluids.

- Multiple conductors color coded.
- Cables labeled as to which equipment, connector they belong.
- Lines labeled as to function, sub-function, hazard, flow: FIG 12.H.1.
- ID tapes encircle the line.
- ID tags, bands on cold, hot lines: stainless over 4" no near intakes.
- Line color symbol (thermal) code: FIG 12.H.2 (12.H.3) (12.H.4).
- Dangerous voltage placarded.
- Hydraulic, electric: FIG 12.H.5-6.

- Number, types, minor rate with stress, low.
- Captive fasteners using them are critical need frequent removal.
- Plugs have min number.
- Only standard tools & adapters for pin co-hand tightened.
- Connectors are common, lines, fasteners.
- Fasteners used outside under all environment.
- Removal of plug, cap expose hot leads.
- Plug of one voltage inserted into the another voltage rate.
- All hot contacts are internal-griphead: critical to mechanical safety.
- Use captive type du necessary.
- Caps, inserts, cover: provided where needed.

Securing devices or package or holding the test item. Plugs, sockets, quick-disconnect fittings for the above. Includes components for transport as well as for stationary use.

- It is impossible to plug into a receptacle.
- Plugs, receptacles for insertion.
- Aligning pin, external electrical pins.
- Plugs, receptacles or air, pins are oriented position.
- Don't store placed: does not cause damage.
- Fastener, connector: are easily accessible.
- Internal screw, bolt throughout: one remove.
- Non-interchangeable different use.
- Cotter keys: snug fit.
- Size, shape on fast match: FIG 13.H.1.
- Connectors are pins when lines carry diff chargeable.
- Fastener heads: large grasped, handled.

- Bolts requiring high external-griphead.
- Fasteners, plugs: must be tightened, loose.
- Over 10 ft-lb, 10 ft-lb: griphead: below 10 ft-lb, external or comb.
- Quick disconnect, release, twist up: for frequent, critical.
- Tighten CW; loosen CCW.

- Gross (limiting) gross 95th % (5th % user: FIG 25.3.1-7).
- Adequate space available connectors.
- Abstract lines to user.
- Connectors are up (1.25") if used with fingers.
- Connectors must be bulky, restrictive clg.

- Connectors visible, c.
- Labels, codes visible.
- Connectors state.
- Easy visual access starting threads, pins.
- ID colors are read from each other or tional lighting.

- Number, types, minor rate with stress, low.
- Captive fasteners using them are critical need frequent removal.
- Plugs have min number.
- Only standard tools & adapters for pin co-hand tightened.
- Connectors are common, lines, fasteners.
- Fasteners used outside under all environment.
- Removal of plug, cap expose hot leads.
- Plug of one voltage inserted into the another voltage rate.
- All hot contacts are internal-griphead: critical to mechanical safety.
- Use captive type du necessary.
- Caps, inserts, cover: provided where needed.

- Number, types, minor rate with stress, low.
- Captive fasteners using them are critical need frequent removal.
- Plugs have min number.
- Only standard tools & adapters for pin co-hand tightened.
- Connectors are common, lines, fasteners.
- Fasteners used outside under all environment.
- Removal of plug, cap expose hot leads.
- Plug of one voltage inserted into the another voltage rate.
- All hot contacts are internal-griphead: critical to mechanical safety.
- Use captive type du necessary.
- Caps, inserts, cover: provided where needed.

- Number, types, minor rate with stress, low.
- Captive fasteners using them are critical need frequent removal.
- Plugs have min number.
- Only standard tools & adapters for pin co-hand tightened.
- Connectors are common, lines, fasteners.
- Fasteners used outside under all environment.
- Removal of plug, cap expose hot leads.
- Plug of one voltage inserted into the another voltage rate.
- All hot contacts are internal-griphead: critical to mechanical safety.
- Use captive type du necessary.
- Caps, inserts, cover: provided where needed.

- Number, types, minor rate with stress, low.
- Captive fasteners using them are critical need frequent removal.
- Plugs have min number.
- Only standard tools & adapters for pin co-hand tightened.
- Connectors are common, lines, fasteners.
- Fasteners used outside under all environment.
- Removal of plug, cap expose hot leads.
- Plug of one voltage inserted into the another voltage rate.
- All hot contacts are internal-griphead: critical to mechanical safety.
- Use captive type du necessary.
- Caps, inserts, cover: provided where needed.



| 12. CABLES  | 13. FASTENERS, CONNECTORS  | 18. INSTRUMENTS, TOOLS  | 19. ACCESSORIES, COVERS, CAPS  | 21. REPLACEABLE ITEMS   |
|---|--|---|--|---|
| <p>Wires, hoses, pipes, hoses from or to the quick-disconnect fittings for transport or use.</p> <p>bound into coils, spools, cables internal to panels to chassis, originating on panel, do not go to be accessible, repair, component parts reachability clothing, is provided to handle cables, cable storage, spaced every 12".</p> <p>is enough to allow it to be checked, consider cables provide, shape coded, standardized so lines intent are not inter- a, shape coded for n.</p> <p>or common tools, use CCW.</p> <p>provided to handle cables &amp; connectors, operation, maintenance.</p> <p>at line ends, inter- vents, etc. nt are adjacent to clean outs, flow- branch lines, at- re line goes thru- le color contrasts- cation, disconnection</p> <p>outputs are mini- g functions, able, visible, y, awkward exten- for handling, pinched by doors, used as handholds; easily, etc. covers, inserts are easy.</p> <p>arded if temp over- handles, are have retaining a line and source. if its an fuel service vent over/low, spill- routed away from, flammable fluids.</p> <p>is color coded, is to which equip- they belong. to function, with- flow: FIG 12.H.1. the line. in cold, hot lines: (1) (12.H.4) code: (1) (12.H.4). placarded: FIG 12.H.5-6.</p> | <p>Securing devices used to assemble, package or hold item in place. Includes: hooks, screws, bolts, nuts, fasteners. Both quick release and tool operated.</p> <p>Includes fastener and connector alignment and locking devices such as lock pins, safety wires, pins, nuts, electrical plugs, and fittings.</p> <ul style="list-style-type: none"> <li>It is impossible to insert a wrong plug into a receptacle.</li> <li>Plugs, receptacles have aligning pins for insertion.</li> <li>Aligning pins extend beyond plug electrical pins.</li> <li>Plugs, receptacles arranged so aligning pins are oriented in the same relative position.</li> <li>Connectors placed so that spillage does not cause damage.</li> <li>Fastener, connector operating parts are easily accessible.</li> <li>Identical screw, bolt heads provided throughout for removal tool.</li> <li>Interchangeable connectors for different use.</li> <li>Coil key: wing tip, large head.</li> <li>Large, shape coded pins avoid mis- match: FIG 13.H.1.</li> <li>Connectors are physically different when they carry different fluids.</li> <li>Fastener heads large enough to be grasped, handled.</li> <li>Bolts requiring high torque have an external griphead.</li> <li>Fasteners, plugs require one turn much to tighten, loosen.</li> <li>Over 10 lb (4.5 kg) torque use external griphead; below 10 lb (4.5 kg) use internal, external or cam-type gripheads.</li> <li>Quick disconnect, snap action, release, twist: up to one full turn for 6.6, critical use.</li> <li>Tighten CW, loosen CCW.</li> <li>Cross (limiting) dimensions based on 95th (5th) operator's hand, arm: FIG 25.B.1-2.</li> <li>Adequate space available to grasp connectors firmly.</li> <li>Adequate space to use connector wrench.</li> <li>Capable of being used as removable.</li> <li>Connectors are separated by 0.75" (1.9 cm) if used with bare (gloved) fingers.</li> <li>Connectors easily reached by user in bulky, restrictive clothing.</li> <li>Connectors visible, accessible.</li> <li>Labels, codes visible in connected, unconnected state.</li> <li>Easy visual access is provided for starting threads, pins.</li> <li>ID colors are readily distinguishable from each other under real operational lighting.</li> <li>Number, type: minimum commensurate with wiring, handling requirements.</li> <li>Captive fasteners used where dropping them creates hazard: covers need frequent removal.</li> <li>Bolts have min number of turns.</li> <li>Only standard tools are used.</li> <li>Adapters for pin connectors can be hand tightened.</li> <li>Connectors are compatible with cables, lines, fasteners, mounting.</li> <li>Fasteners used outside are operable under all environmental conditions.</li> <li>Removal of plug, connector does not expose hot lines.</li> <li>Plug of one voltage rating cannot be inserted into the receptacle of another voltage rating.</li> <li>All hot contacts are sockets.</li> <li>Internal griphead: only use when critical to mechanical function, personnel safety.</li> <li>Use captive type dust covers where necessary.</li> <li>Caps, inserts, covers, cones, shields provided where necessary.</li> <li>Receptacles marked as to voltage, phase, frequency.</li> <li>Connecting plugs, receptacles identified by color, size.</li> <li>Plugs, receptacles have stripes, arrows, etc to show aligning pin position.</li> <li>Manner of connection obvious.</li> <li>Non-standard operating direction is clearly marked.</li> <li>Plug, receptacle identifications: FIG 13.H.1.</li> </ul> | <p>Common and special tools and test instruments for assembly, adjustment, calibration and alignment.</p> <p>Includes special maintenance equipment such as lubrication points, pouring spouts, filter tubes and nozzles.</p> <ul style="list-style-type: none"> <li>Cables terminating on control, display panels do not interfere with controls, displays.</li> <li>Test points reflect the sequence for sequential testing.</li> <li>Test points for adjustment are close to the controls, displays used.</li> <li>Special tools required for adjustment are with equipment.</li> <li>Test points are accessible.</li> <li>Limiting body dimensions based on 5th% user for reaching test points: FIG 25.B.1.</li> <li>Sequential adjustment points have a hand, arm rest nearby if vibration is present during adjustment.</li> <li>Cables are long enough to check unit in place.</li> <li>Braces hold hinged assays in working position.</li> <li>Test equipment fits the hand or has handle, hand support.</li> <li>Calibration, adjustment controls with limited motion have mechanical stops to prevent damage.</li> <li>Access to unit maintained by one technician does not require removal of one maintained by another.</li> <li>Stands, casters (wheels, hoist-lifting) is provided for equipment exceeding 30 lb (13.6 kg).</li> <li>Adequate storage provided in portable test equipment cases, lid to contain leads, probes, spares, manuals, tools.</li> <li>Large parts are not mounted to deny access to smaller ones.</li> <li>Sufficient space provided for test equipment, tool use without difficulty, hazard.</li> <li>Sensitive adjustment points, guarded against accidental disturbance.</li> <li>Indication of equipment power failure provided.</li> <li>Test, adjustment, check point and cables, connectors, labels are accessible, visible during maintenance.</li> <li>Positive indication of open fuse.</li> <li>Non-visual screwdriver adjustments have mechanical shaft guide.</li> <li>Test equipment has panel lighting.</li> <li>Special tool use minimized.</li> <li>Knobs preferred to screwdriver for frequent adjustment.</li> <li>Lamp test circuits incorporated.</li> <li>Lamp replacement is possible with power on, from panel front.</li> <li>Tools provided with rings, eyes compatible with quick-release snaps, heads on tool belts.</li> <li>Test equipment is not overly complex, difficult to use.</li> <li>Electrical hand-held tools have 3-wire power with ground or are double insulated.</li> <li>Exposed surfaces of electrical hand-held tools are non-conducting or grounded.</li> <li>Contacts, terminals are shielded with suitable protective measures to prevent accidental contact.</li> <li>Internal controls located near hazards are shielded, labeled.</li> <li>Test points permanently labeled, color coded.</li> <li>Operating instructions for portable test equipment affixed to unit, lid or compartment.</li> <li>Calibration reminder included with test instructions.</li> <li>Reference scale is provided for control adjustment.</li> <li>A simple check shows when equipment is out of calibration.</li> </ul> | <p>Those openings in an item that allow manipulation of controls, connection and disconnection of fasteners, visual checking of displays or components utilizing test points, and inserting or removing materials.</p> <p>Included is the access covering, if any.</p> <ul style="list-style-type: none"> <li>Sliding, rotation, hinged units open, rotate their full distance, remain in place without hand support.</li> <li>Cover mounting holes large enough to permit attaching screws to pass without perfect alignment.</li> <li>Covers not completely removable are self supporting.</li> <li>Trainer van doors: appropriate for equipment access: lock open, closed; inner quick release.</li> <li>Access large enough to insert arm, hand, tools, test equipment.</li> <li>Gross (limiting) dimensions based on 95th (5th) user: FIG 25.B.1-2.</li> <li>Whole body access: FIG 4.B.1.</li> <li>Hand, arm, finger access: FIG 19.B.1.</li> <li>Rectangular (round (oval)) hatch dimensions: FIG 4.B.1 (30" dia) (117" x 28").</li> <li>Caps are large enough to be handled with gloves.</li> <li>Requirements to see, work within access determine:</li> <li>1. Locked access user: FIG 25.B.1.</li> <li>2. Structural members do not prevent access to components.</li> <li>3. Replaceable items are not placed in a manner which makes them difficult to remove.</li> <li>4. Small covers hinge at bottom, open down.</li> <li>5. Cover latch requires positive force to open, is within capability or 5th% user: FIG 4.C.1.</li> <li>6. Caps tighten CW, loosen CCW.</li> <li>7. One man can lift cover.</li> <li>8. Bulkheads, brackets don't interfere with opening, removing covers where work is done.</li> <li>9. Openings are large enough to permit required operations.</li> <li>10. Allowance is made for gloved hand in externally located access.</li> <li>11. Open covers do not interfere with controls, displays.</li> <li>12. Visual access cover preferences: none, transparent, break-resistant glass, quick opening metal.</li> <li>13. It is obvious when a cover is in place but not secured.</li> <li>14. Visual access only for components requiring a visual check.</li> <li>15. Instructions visible when access cover is open.</li> <li>16. Openings allow visibility of internal components while operator performs tasks.</li> <li>17. Access provided if frequent maintenance requires removing case, covers, mounting components.</li> <li>18. Access covers are equipped with grasp areas for opening.</li> <li>19. Physical access cover preferences: none, sliding, hinged, quick-opening.</li> <li>20. Captive fasteners used when periodic removal is required.</li> <li>21. Either hinged cover used or minimum number of captive fasteners.</li> <li>22. Cover fasteners self lock for closing with audible snap.</li> <li>23. Edges, corners on covers, cases are rounded to prevent injury.</li> <li>24. Hazardous voltage behind access cover is de-energized with an interlock attached to cover.</li> <li>25. Access over dangerous mechanical, electrical component has an internal light, warning on door.</li> <li>26. Pressurized caps are captive.</li> <li>27. Cover opening method is obvious or instructions are displayed on outside of cover.</li> <li>28. Accesses are labeled with warning sign advertising of hazards within, precautions needed.</li> <li>29. Labels indicate function of units behind enclosure, access.</li> <li>30. Labels, instructions are properly oriented when cover, case, door is open.</li> <li>31. Labels indicate how service equipment is oriented, connected.</li> </ul> | <p>Reservoir fill points and drains for lubricants, hydraulic fluids, other liquids, air, gases, etc.</p> <p>Filters for fuel, oil, air.</p> <p>Includes vacuum tubes, electronic modules and low MTBF parts.</p> <ul style="list-style-type: none"> <li>Don't need to disassemble to lubricate, replaceable units remain open without support; well laid out; readily accessible.</li> <li>Fuses easily accessible.</li> <li>Vehicle drain valves, fuel/oil filters, distributors, fuel injectors, fan belts, etc are accessible for inspection, replacement.</li> <li>All tire valves accessible.</li> <li>Parts mounted on one plane.</li> <li>Legend screens, indicator covers cannot be interchanged.</li> <li>Similarly shaped items with different function have standard orientation throughout; easily identified; not interchangeable.</li> <li>Positive, negative battery terminals are different sizes.</li> <li>Radiator fill neck large enough to accept filler.</li> <li>Blind screwdriver adjustments have mechanical guides.</li> <li>Sensitive adjustments guarded; hand support provided.</li> <li>Weighted limits for one man lift: FIG 14.C.1; if shape is convenient, handles are provided; lift is not repeated, item is not carried.</li> <li>Horizontal push, pull force limits: FIG 14.C.2.</li> <li>Units that are pulled out of item are mounted on rollout racks, slides, hangers.</li> <li>Simple indicator lights have clearance for easy bulb replacement.</li> <li>Large parts do not prevent access to other parts.</li> <li>Check, adjustment, test points; connectors; labels are accessible during maintenance.</li> <li>Enough clearance is provided to replace parts without contacting hardware.</li> <li>Fill points, drains reachable by 5th% user in restrictive, clothing.</li> <li>Timing marks, other adjustment indicators minimize parallax, are readily visible.</li> <li>Reference scales visible.</li> <li>Components visible from maintenance position.</li> <li>Maintenance points contrast with background.</li> <li>Lighting: indicators incorporate filament redundancy/filament lamps.</li> <li>Fruity equipment is easily detected, quickly removed, repaired using standard parts, modules.</li> <li>Delicate parts are protected.</li> <li>Lamps replaceable with power on.</li> <li>Critical, low MTBF parts are the most accessible.</li> <li>Common hand tools for field units.</li> <li>Grasp areas on carried units.</li> <li>Guide pins, rollout racks, interlocks, drawers, hinges, quick-disconnects aid removal, replacement.</li> <li>Item failure indicator or alarm.</li> <li>Internal controls located near rotating parts, high volts, other hazards are shielded.</li> <li>Units can be accessed without danger from heat, moving parts, electricity, chemicals, radiation.</li> <li>External parts are grounded.</li> <li>Pressurized components have bleed valve.</li> <li>Ports, components, circuits, assemblies meaningfully labeled.</li> <li>Lube points labeled as to type, frequency.</li> <li>Items exceeding one man lift labeled with weight, limitation.</li> <li>Moist, jack, lift points; CGs (no-step) weights labeled.</li> <li>Replaceable items coded, keyed.</li> <li>Fuses labeled, rated.</li> <li>Battery terminals marked "+", "-", hazardous conspicuously placarded.</li> <li>Grasp areas identified.</li> </ul> |

- Design Requirements (MIL-STD-1472)
- User-Computer Interface Data (MIL-STD-1472C)
- Guidance Data (MIL-HDBK-759, Etc.)



## TEST FUNCTION

**TEST ITEM CLASS IV**

**OBJECTIVE:** Evaluate electronics and signal systems for the ability of the maintainer to effectively and safely perform preventive maintenance as well as to repair or remove and replace any malfunctioning component found during non-scheduled maintenance. The HFE subtest should consider evaluation of user performance and safety for these functions under conditions representative of those expected in actual use.

1. User
2. Envi  
and
3. One  
de  
oot

| PERFORM PREVENTIVE MAINTENANCE   |   |   |
|--|---|---|
| SERVICE  | INSPECT/CHECKOUT  | TRoubleshooting   |
| <p>PURPOSE: Evaluate the design of the item for enabling the technician to perform servicing activities.</p> <p>MAN/ITEM TASKS</p> <ul style="list-style-type: none"> <li>Access components.</li> <li>Tighten components.</li> <li>Clean components.</li> <li>Align components.</li> <li>Adjust components.</li> <li>Calibrate components.</li> <li>Remove components.</li> <li>Replace components.</li> </ul> | <p>PURPOSE: Evaluate the item design for visual inspection and checkout.</p> <p>MAN/ITEM TASKS</p> <ul style="list-style-type: none"> <li>Acquire checklist.</li> <li>Access components.</li> <li>Adjust controls.</li> <li>Read displays.</li> <li>Read labels.</li> </ul> | <p>PURPOSE: Evaluate the item design for enabling the technician to identify faults to the component.</p> <p>MAN/ITEM TASKS</p> <ul style="list-style-type: none"> <li>Activate control.</li> <li>Acquire performance.</li> <li>Read displays.</li> <li>Access test point.</li> <li>Activate test equipment.</li> <li>Read signals.</li> <li>Make decisions.</li> </ul> |

[illegible]



## ELECTRONICS/SIGNALS

1. User conditions - body size, clothing and encumbrances, technician skills;
2. Environmental conditions - weather, temperature, noise, vibration, climate and illumination levels;
3. Operational conditions - use conditions (different types of failures to be detected, isolated and repaired, and different work pieces) and time critical operations (quick fix, rapid troubleshooting, etc.).







[illegible]



## TEST ITEM CLASS V

### The conditions

1. User conditions
2. Environmental and illumination
3. Operational conditions detected, isolation operations (quit)

| PERFORM PREVENTIVE MAINTENANCE  |  | PERFORM NON-SCHEDULED MAINTENANCE   |   |
|---|--|---|---|
| INSPECT/CHECKOUT  | PERFORM ROUTINE P M  | DETECT MALFUNCTION  | REPAIR/REPLACE  |
| <p><b>PURPOSE:</b> Evaluate the design of the test item for enabling a thorough preoperational check to be performed.</p>   | <p><b>PURPOSE:</b> Evaluate the test item for ease and safety in the performance of routine preventive maintenance tasks, bearing in mind that tasks difficult to perform or components hard to find or reach will be more likely overlooked or avoided in a standard field situation.</p> | <p><b>PURPOSE:</b> Evaluate the test item for adequacy of information provided to the operator regarding operating condition of various parts of the item.</p>              | <p><b>PURPOSE:</b> Evaluate the test item for ease and safety in the performance of repair and replacement tasks.</p>   |
| <p><b>MAN/ITEM TASKS</b></p> <p>Inspect structural components.</p> <p>Check tightness of fasteners/connectors.</p> <p>Determine status of expendable materials.</p> <p>Determine condition/expected life of line replaceable parts.</p> <p>Verify operational status of displays.</p> | <p><b>MAN/ITEM TASKS</b></p> <p>Clean/paint.</p> <p>Add preservatives.</p> <p>Remove/replace minor items (lightbulbs/filters).</p> <p>Lubricate.</p> <p>Add expendables.</p> <p>Tighten fasteners/connectors.</p> <p>Adjust/calibrate/align components.</p>                                | <p><b>MAN/ITEM TASKS</b></p> <p>Monitor displays.</p> <p>Utilize visual/auditory cues.</p> <p>Detect changes in system operation.</p> <p>Read malfunctioning indicator.</p> | <p><b>MAN/ITEM TASKS</b></p> <p>Monitor displays.</p> <p>Utilize visual/auditory cues.</p> <p>Detect changes in system operation.</p> <p>Read malfunctioning indicator.</p> |

[illegible]











[illegible]



## TEST FUNCTION

OBJECTIVE: Evaluate the item under test for its capacity to be effectively and safely transported, including any special preparations necessary for loading and unloading. The HFE subtest should consider evaluation of user performance and safety for these functions under conditions representative of those expected in actual use.

1  
2  
3

| PREPARE FOR TRANSPORT  |   |   |
|--|---|---|
| PLACE IN TRANSIT CONFIGURATION   | PACKAGE   | ON  |
| <p>PURPOSE: Travel configurations are of two types. One type is a combat ready status that will allow the item to be fully utilized immediately on off-loading, as with combat vehicles. The other is a routine shipping status, which may involve disassembly, folding, collapsing, or covering of components; coating or filling with preservative; and removal or securing of loose parts. (Airdrop is a special case of the former type.) Evaluate the test item for either or both of the travel configurations, depending on the military characteristics specified for it.</p> <p>MAN/ITEM TASKS</p> <p>Position/lock movable components.</p> <p>Remove/secure loose/projecting components.</p> <p>Apply protective covering.</p> <p>Remove expendable liquids.</p> <p>Connect/remove auxiliary equipment (fording/winterizing kits).</p> <p>Add preservatives.</p> | <p>PURPOSE: Evaluate the test item for ease of packaging including disassembly, preparation for packaging, insertion and securing in the package. (Package here refers to boxes, cartons, canvas and plastic covers and cases, and other containers or covers for the test item.)</p> <p>MAN/ITEM TASKS</p> <p>Disassemble item elements.</p> <p>Obtain/construct package.</p> <p>Insert item into package.</p> <p>Insert shock proofing material.</p> <p>Anchor item.</p> <p>Close package.</p> <p>Apply labeling.</p> | <p>PURPOSE: between carrier sign of is carried, planes, the item</p> <p>(The T. Factor: and To found i A.)</p> <p>MAN/ITEM TASKS</p> <p>Attach points</p> <p>Engage component</p> <p>Employ slings/c</p> <p>Attach ing/roll</p> |

| Test Item Components<br>HUMAN FACTORS<br>CONSIDERATIONS | INDEX TO DATA                        |                               |                              |                                      |                                |                               |                   |                             |
|---|--------------------------------------|-------------------------------|------------------------------|--------------------------------------|--------------------------------|-------------------------------|-------------------|-----------------------------|
|   | Labels<br>Manuals<br>Markings<br>(1) | Operating<br>Elements<br>(16) | Replaceable<br>Items<br>(21) | Labels<br>Manuals<br>Markings<br>(1) | Fastener<br>Connectors<br>(13) | Operating<br>Elements<br>(16) | Packaging<br>(17) | Fastener<br>Connect<br>(13) |
| A. LOCATION & ARRANGEMENT                               | A                                    | A                             | A                            | A                                    | A                              | A                             | A                 | A                           |
| B. SIZE & SHAPE   | B                                    |                               | B                            | B                                    | B                              |                               | B                 | B                           |
| C. DIRECTION & FORCE                                    |                                      | C                             | C                            |                                      | C                              | C                             | C                 | C                           |
| D. CLEARANCE  | D                                    | D                             | D                            | D                                    | D                              | D                             | D                 | D                           |
| E. VISIBILITY   | E                                    | E                             | E                            | E                                    | E                              | E                             | E                 | E                           |
| F. USE CONDITIONS                                       | F                                    | F                             | F                            | F                                    | F                              | F                             | F                 | F                           |
| G. SAFETY   | G                                    | G                             | G                            | G                                    | G                              | G                             | G                 | G                           |
| H. OPERATING PROCEDURES                                 | H                                    | H                             | H                            | H                                    | H                              | H                             | H                 | H                           |



## TRANSPORTABILITY

item under test for safety and safety transfer preparations necessary. The HFE subtest of user performance was under conditions cited in actual use.

**The conditions applicable to this class includes**

1. User conditions - body size, clothing, and number of users;
2. Environmental conditions - weather, climate, terrain and illumination levels;
3. Operational conditions - use conditions (type of preparation, disassembly, packaging for transport) and time critical operations (combat ready, air drop).

|   | LOAD/UNLOAD  | SECURE/UNFASTEN  |  |
|---|--|--|--|
|   | DRIVE/TOW/LIFT<br>ONTO/INTO/OUT OF CARRIER   | IMMOBILIZE ITEM  | PREPARE FOR USE  |
| est item for<br>disassembly,<br>insertion and<br>package here<br>canvases and<br>d other con-<br>item.) | <p><b>PURPOSE:</b> Evaluate the relationship between the test item and standard carriers, to determine whether the design of the test item and/or its packaging is compatible with driving, being towed, lifted, pushed or pulled into or onto planes, ships, trucks, railroad cars and the item's subsequent removal.</p> <p>(The Test Item Components and Human Factors Considerations for the Driving and Towing task are the same as will be found in Operability I A, I C, and III A.)</p> <p><b>MAN/ITEM TASKS</b></p> <p>Attach/remove hooks/cables to lifting points on item or package.</p> <p>Engage item with material handling components (forks).</p> <p>Emplace item on/in pallets/cargo nets/slings/other lifting and loading devices.</p> <p>Attach item where required-lifting/sliding/rolling item to do so.</p> | <p><b>PURPOSE:</b> Evaluate the item for location and usability of tie-down points insofar as they relate to standard tie-down points in carriers.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Secure ties to item.</p> <p>Secure ties to carrier.</p> <p>Increase/decrease tension of ties during or after initial task.</p> <p>Check out tie-downs during transit to verify connection/tension.</p> <p>Check wheels/lock tracks.</p> | <p><b>PURPOSE:</b> Evaluate the test item and package for ease of tasks required for preparation for use under normal (rear echelon) conditions as well as under combat tactical constraints of time and defensive or offensive activity.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Open package.</p> <p>Remove item or components.</p> <p>Assemble item.</p> <p>Clean/lubricate/etc.</p> <p>Install/set up/distribute item.</p> |

## INDEX TO DETAILED DESIGN CONSIDERATIONS

[illegible]







IG

## 21 REPAIRABLE ITEMS

ed for packaging, protection, covers, bases, bags, are not part of the for transport, and storage housed for the item, or tem, and are part of tion.

Reservable fill points and drains for liquids, gases, hydraulic fluids, other liquids, air, gases, etc.  
Filters for fuel, oil, air.  
Includes vacuum tubes, electronic modules and low MTBF parts.

n units rather than ones.  
owed away from en- exhaust pipes.  
y apd items secured or restrained by

- Don't need to disassemble to lub.
- Replaceable units remain "open" without supports well laid out readily accessible.
- Fuses easily accessible.
- Vehicle drain valves, fuel/oil filters, distributors, fuel injectors, fan belts, etc are accessible for inspection, replacement.
- All tire valves accessible.

cessible by 5-95th% S.B.I-7.

- Similarly shaped items with different function have standard orientation throughout; easily identified; not interchangeable.
- Positive, negative battery terminals are different sizes.
- Radiator fill neck large enough to accept filter.

- Design Requirements (MIL-STD-1472)
- User-Computer Interface Data (MIL-STD-1472C)
- Guidance Data (MIL-HDBK-759, Etc.)

hese quick releases:

- Blind screwdriver adjustments have mechanical guides.
- Sensitive adjustments guarded; hand support provided.
- Weighted limits for one man lifts FIG 14.C.1; If shape is convenient, handles are provided. If not repeated, item is not carried.
- Horizontal push, pull force limits FIG 14.C.2.
- Units that are pulled out of them are mounted on rollout racks, slides, hinges.
- Simple indicator lights have clearance for easy blind replacement.
- Large parts do not prevent access to other parts.
- Check, adjustment, test points; connectors; labels are accessible during maintenance.
- Enough clearance is provided to replace parts without contacting hardware.
- Fill points, drains reachable by 5th % user in restrictive clothing.
- Timing marks, other adjustment indicators minimize parallax, are readily visible.
- Reference scales visible.
- Lighted indicators incorporate filament redundancy/dual lamps.

h larger than units  
event damage when  
replacement.  
age avoided,  
for full hand, fin-  
hen using opening  
-erance provided  
missiles exceeding  
r retainer with e-  
ar 95th% hand.

a cover is in place  
package contents

aps are used to  
ound equipment  
a, use.  
state obvious.  
part of vehicle,  
ments,  
and in racks.

- Faulty equipment is easily detected, quickly removed, repaired using standard parts, modules.
- Delicate parts are protected.
- Lamps replaceable with power on.
- Common hand tools for field units.
- Guide pins, rollout racks, interlocks, drawers, hinges, quick-disconnects aid removal, replacement.
- Item failure indicator or alarm.
- Remote handling devices compatible have quick disconnects, captive fasteners, feedback.
- Internal controls located near relating parts, high volts, other hazards are shielded.
- Rollout racks: stops provided; CG does not overshift, topple item.
- Units can be accessed without damage from heat, moving parts, electricity, chemicals, radiation.
- Fuel service equipment has automatic shutoff device.
- External parts are grounded.
- Pressurized components have bleed valves.
- Parts, components, circuits, assemblies unambiguously labeled.
- Lub points labeled as to type, frequency.
- Items exceeding one man lift labeled with weight, limitation.
- Hand, push, lift points CG (heavy) weight labeled.
- Flexible items coded, keyed.
- Fuses labeled, rated.
- Battery terminals marked "+", "-".
- Hazards conspicuously placarded.
- Group areas identified.

covers, cases are  
finished to pre-  
ary.

and within its cov-  
er.  
tell how to open,  
screw, cases,  
hazards, dangers  
labeled.



## TEST PLAN/TEST

**OBJECTIVE:** Evaluate the item under test for its capacity to be effectively and safely carried or utilized by appropriate personnel. The HFE subtest should consider evaluation of user performance and safety for these functions under conditions representative of those expected in actual use.

The conditions applicable to this c

1. User conditions - body size and etc
2. Environmental conditions - weather
3. Operational conditions - time of day, conditions (noise, vibration, etc)

| CARRY/WEAR ITEM  |   |   |  |
|--|---|---|--|
| DON/OFF  | WEAR  | CARRY ITEM  | PERFORM  |
| <p><b>PURPOSE:</b> Evaluate the design of the test item for ease of mounting on or attaching to the body, for covering the body, or for attaching to other body mounted components, and for the ease of removing or taking it off.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Put on/take off shirt/gloves/boots/trousers/protective clothing.</p> <p>Button/snap/tie clothing.</p> <p>Attach/emplace load into/onto pack/load carrier/carrying case.</p> <p>Buckle straps/snap catches/otherwise attach portable gear to body/cartridge belt/pack harness.</p> | <p><b>PURPOSE:</b> Evaluate the design of the test item for ease, safety, and comfort as it is worn by the individual soldier.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Use headwear.</p> <p>Use handwear.</p> <p>Use footwear.</p> <p>Wear clothing.</p> <p>Wear personal equipment items (back-pack/cartridge belt/etc.)</p> | <p><b>PURPOSE:</b> Evaluate the item for ability of users to effectively, safely, and comfortably carry it during routine, non-combat operations, including walking, mounting/dismounting vehicles, climbing stairs and ladders.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Carry item on back/body (no hands).</p> <p>Adjust carrying elements (straps/holders).</p> <p>Carry item in one/both hands.</p> <p>Carry item by one or more men.</p> | <p><b>PURPOSE:</b> Evaluate the item for ability of user to perform combat or wearing it in normal combat. These include crawling, jumping, throwing, etc. through water obstacles, dig defense, post through, under entrenching to evaluated in given under "L Combat Function would be evaluated.</p> <p><b>MAN/ITEM TASKS</b></p> <p>Fasten item so flapping/interf.</p> <p>Discard item vegetation/bar.</p> <p>Disconnect/rating is a problem.</p> <p>Carry item combat tasks.</p> <p>Eliminate noise relative to the.</p> <p>Cover/modify to insure camouflage.</p> |

| Test Item Components<br>HUMAN FACTORS<br>CONSIDERATIONS | Headwear<br>(22) | Handwear<br>(23) | Footwear<br>(24) | Clothing<br>(25) | Load Carrying<br>Devices<br>(27) | Headwear<br>(22) | Handwear<br>(23) | Footwear<br>(24) | Clothing<br>(25) | Load Carrying<br>Devices<br>(27) | Handles<br>(14) | Stepping<br>Gear<br>(26) | Load Carrying<br>Devices<br>(27) | Connect<br>Hardware<br>(21) | Headwear<br>(22) | Handwear<br>(23) |
|---|------------------|------------------|------------------|------------------|----------------------------------|------------------|------------------|------------------|------------------|----------------------------------|-----------------|--------------------------|----------------------------------|-----------------------------|------------------|------------------|
| A. LOCATION & ARRANGEMENT                               |                  |                  |                  |                  | A                                |                  |                  |                  |                  | A                                | A               |                          | A                                | A                           |                  |                  |
| B. SIZE & SHAPE   | B                | B                | B                | B                | B                                | B                | B                | B                | B                | B                                | B               | B                        | B                                | B                           | B                | B                |
| C. DIRECTION & FORCE                                    |                  |                  |                  |                  | C                                |                  |                  |                  |                  | C                                | C               |                          | C                                | C                           |                  |                  |
| D. CLEARANCE  | D                | D                | D                | D                | D                                | D                | D                | D                | D                | D                                | D               |                          | D                                | D                           | D                | D                |
| E. VISIBILITY   | E                | E                | E                | E                | E                                | E                | E                | E                | E                | E                                | E               | E                        | E                                | E                           | E                | E                |
| F. USE CONDITIONS                                       | F                | F                | F                | F                | F                                | F                | F                | F                | F                | F                                | F               | F                        | F                                | F                           | F                | F                |
| G. SAFETY   | G                | G                | G                | G                | G                                | G                | G                | G                | G                | G                                | G               | G                        | G                                | G                           | G                | G                |
| H. OPERATING PROCEDURES                                 | H                | H                | H                | H                | H                                | H                | H                | H                | H                | H                                | H               | H                        | H                                | H                           | H                | H                |



## PORTABILITY/USABILITY

**The conditions applicable to this class include:**

1. User conditions - body size and clothing;
2. Environmental conditions - weather, terrain, climate (desert, arctic, swamp);
3. Operational conditions - time critical operations (emergency use, removal), combat conditions (noise suppression, blackout, NRC) and use conditions (duration of use).

|  |  | UTILIZE ITEM  |  |
|--|--|---|--|
| M  | PERFORM COMBAT FUNCTIONS   | PREPARE FOR USE   | USE  |
| <p>item for ability safely, and com- routine, non- uding walking, icles, climbing</p> <p>so hands).</p> <p>(straps/ hold-</p> <p>ds.</p> <p>men.</p> | <p>PURPOSE: Evaluate the item for ability of user to perform routine and contingency combat type tasks while carrying or wearing it in conjunction with the normal complement of combat gear. These include, but are not limited to, crawling, jumping, firing weapons, throwing grenades, running, wading through water, climbing over and under obstacles, digging or otherwise preparing defense positions, and breaking trail through underbrush. The use of an entrenching tool, for example, would be evaluated in accordance with guidance given under "Utilize Item". In "Perform Combat Functions", an entrenching tool would be evaluated <u>only</u> for its portability.</p> <p>MAN/ITEM TASKS</p> <p>Fasten item securely to body to prevent flapping/interference.</p> <p>Discard item in emergency (snagged on vegetation/barbed wire).</p> <p>Disconnect/raise item for wading if wet- ting is a problem.</p> <p>Carry item while performing various combat tasks.</p> <p>Eliminate noise sources caused by or relative to the item.</p> <p>Color/modify visible/reflecting surfaces to insure camouflage.</p> | <p>PURPOSE: Evaluate the test item for ease of preparation for use, including minor assembly or connection, field level alignment or adjustment, gaining access to operating components, uncovering, cleaning or connecting optical components, and other tasks required for final preparation of an item for use.</p> <p>MAN/ITEM TASKS</p> <p>Open access flaps or covers.</p> <p>Remove item from case.</p> <p>Connect components.</p> <p>Extend/fasten collapsible/folding com- ponents.</p> <p>Manipulate adjustment controls.</p> <p>Verify operational status.</p> <p>Clean/adjust optics.</p> | <p>PURPOSE: Evaluate the item for ability of user to perform required tasks easily, safely, and reliably. This task refers only to those items that have a function other than carrying loads, and includes gas masks, goggles, life preserver, en- trenching tool, and flashlight. (For operability of field radios and detection systems, see Operability IV C.)</p> <p>MAN/ITEM TASKS</p> <p>Put on/adjust item (goggles/life pre- server).</p> <p>Use item as designed (dig/illuminate).</p> |

### DETAILED DESIGN CONSIDERATIONS.

| Wearing<br>ces<br>(1) | Combat<br>Hard-<br>Ware<br>(28) | Head-<br>wear<br>(22) | Hand-<br>wear<br>(23) | Foot-<br>Wear<br>(24) | Clothing<br>(25) | Load<br>Carrying<br>Devices<br>(27) | Sleeping<br>Gear<br>(26) | Load<br>Carrying<br>Devices<br>(27) | Combat<br>Hardware<br>(28) | Labels<br>Manuals<br>Markings<br>(1) | Load<br>Carrying<br>Devices<br>(27) | Combat<br>Hardware<br>(28) |
|-----------------------|---------------------------------|-----------------------|-----------------------|-----------------------|------------------|-------------------------------------|--------------------------|-------------------------------------|----------------------------|--------------------------------------|-------------------------------------|----------------------------|
| A                     | A                               | B                     | B                     | B                     | B                | B                                   | B                        | a                                   | B                          | A                                    | A                                   | A                          |
| B                     | B                               | B                     | B                     | B                     | B                | B                                   | B                        | a                                   | B                          | B                                    | B                                   | B                          |
| C                     | C                               | D                     | D                     | D                     | D                | C                                   | C                        | C                                   | C                          | C                                    | C                                   | C                          |
| D                     | D                               | D                     | D                     | D                     | D                | D                                   | D                        | D                                   | D                          | D                                    | D                                   | D                          |
| E                     | E                               | F                     | F                     | F                     | F                | E                                   | E                        | E                                   | E                          | E                                    | E                                   | E                          |
| F                     | F                               | G                     | G                     | G                     | G                | F                                   | F                        | F                                   | F                          | F                                    | F                                   | F                          |
| G                     | G                               | H                     | H                     | H                     | H                | G                                   | G                        | G                                   | G                          | G                                    | G                                   | G                          |
| H                     | H                               |                       |                       |                       |                  | H                                   | H                        | H                                   | H                          | H                                    | H                                   | H                          |







|  | 24 FOOTWEAR  | 25 CLOTHING  | 26 SLEEPING GEAR  | 27 LOAD CARRYING DEVICES  | 28 COMBAT HANDWARE  |
|--|--|--|---|---|---|
| and arctic gloves as special purpose required for election.  | Includes standard combat boots, antineuro or spike boots, dress shoes, waterproof and arctic footwear, and "soft" shoes (sneakers). Also encompasses socks, stockings, and shoe and foot inserts.  | Includes shirts, trousers, undergarments, jackets, protective clothing (rain, NBC), cold weather clothing, and specialized apparel of various types.   | Includes sleeping bags and covers, blankets, air mattresses, and other items utilized for sleeping.   | Generally, web equipments carried on the body by an individual soldier into a combat situation, which are used to carry, contain or protect other items. Includes packs, pack frames, harnesses, weapons carried, and carrying cases for combat items (ammunition, first aid kits, binoculars, entrenching tools, field telephones).  | A miscellaneous grouping of non-weapon items which are routinely carried into the field, including hygiene items, flashlights, gas mask, canteens, entrenching tool, axes, first aid kits, compasses, etc. Also includes man carried items of a less routine nature, such as binoculars, goggles, and life preservers.  |
| 1 for 5th-95th% is sized for 1st-5th%.   | <ul style="list-style-type: none"> <li>Footwear is sized for 5th-95th% personnel: FIG 25.B.5.</li> <li>Essential, critical footwear is sized for 1st-99th% personnel.</li> <li>Clothed ground troop foot size: FIG 25.B.7.</li> <li>Outside dimensions of boot, shoe are consistent with specs for footholds, ladders.</li> <li>Socks, stockings fit foot snugly without wrinkles.</li> <li>Shoes, boots compatible with foot controls.</li> </ul>   | <ul style="list-style-type: none"> <li>Essential, critical clothing is sized for 1st-99th% personnel.</li> <li>Arctic clothing for 5th-95th% personnel: FIG 25.B.8.</li> <li>Clothed ground troop body dimensions: FIG 25.B.7.</li> <li>Ponchos fitted only for length but must be large enough to cover a fully equipped man.</li> <li>Protective clothing fits snugly at openings.</li> </ul>  | <ul style="list-style-type: none"> <li>Sleeping gear is sized for 5th-95th% personnel: FIG 25.B.13.</li> <li>Essential critical personnel equipment is sized for 1st-99th% personnel.</li> <li>Gear is not excessively bulky when rolled, packed.</li> </ul>  | <ul style="list-style-type: none"> <li>Backpacking aids distribute the load over as many muscle groups as possible.</li> <li>Backpacking aids place the load CG as close to the porter's spine as possible.</li> <li>Load-carrying minimizes pressure applications to chest or armpits.</li> <li>Heavy loads placed close to the body.</li> <li>For rough terrain, climbing heavy items anchored at, near bottom.</li> <li>Carried equipment is sized for 5th-95th% personnel: FIG 25.B.1-4.</li> <li>Adjustable items have range of fit for 5th-95th% user.</li> <li>Maximum use is made of standard load carrying devices.</li> <li>A single size device can accommodate smallest user in tropic clothing to largest user in arctic clothing.</li> </ul>  | <ul style="list-style-type: none"> <li>Items of sufficient size, weight to interfere with balance have proper placement, type of attachment.</li> <li>Items are readily accessible.</li> </ul>  |
| supplies for personnel tasks or other provided. IG 23.B.1.   | <ul style="list-style-type: none"> <li>Footwear size allows for expansion due to heat, load carrying.</li> <li>Shoe, boot fit includes heaviest socks, combination of socks that will be worn.</li> <li>Shoe, boot inserts considered in fitting.</li> </ul>   | <ul style="list-style-type: none"> <li>Fit of combat clothing is liberate rations sometimes carried in shirts; strenuous combat tasks require free limb movement.</li> <li>Ponchos, NBCs, large protective garments cover packs, weapons, etc. carried by man without detracting from man coverage.</li> </ul>   | <div> <ul style="list-style-type: none"> <li>Design Requirements (MIL-STD-1472)</li> <li>User-Computer Interface Data (MIL-STD-1472C)</li> <li>Guidance Data (MIL-HDBK-759, Etc.)</li> </ul> </div>   | <ul style="list-style-type: none"> <li>Load-carrying systems consider the weight, distribution of individual items carried by the user.</li> <li>Rifleman (other) fighting loads: 40 lb (45 lb max); marching loads: 55 lb max.</li> <li>Individual portions of equipment may weigh up to 35 lb; its load is balanced, well distributed; it is not necessary to maintain pace of infantry movement.</li> <li>Two-man carrying stretcher type handles, shoulder support.</li> <li>Suspension, location of device is such that other man-carried items are readily accessible.</li> <li>Continuous rather than discrete adjustment of straps is preferred where snug fit is required.</li> <li>Adjustments can be accomplished while item is in use.</li> <li>Adjustments maintained by means of friction, catches, snaps.</li> </ul> | <ul style="list-style-type: none"> <li>Equipment sizing ensures use by 5th-95th% user: FIG 25.B.1-7.</li> <li>Individual weights of basic rifleman items: FIG 25.B.1.</li> <li>Gas mask, goggles useable with helmet.</li> <li>Pack carried items fold, collapse to take up minimum space.</li> <li>Gas masks, goggles, life preservers are adjustable on personnel, fit snugly.</li> </ul>   |
| large enough to specify flexibility of finger weapons operation.   | <ul style="list-style-type: none"> <li>Eyelets, buckles, fasteners have dull finish non-reflective.</li> </ul>   | <ul style="list-style-type: none"> <li>Metallic, plastic components have dull finish non-reflective.</li> <li>Protective clothing adaptable to various camouflage requirements.</li> </ul>   | <ul style="list-style-type: none"> <li>Inside, outside of bags, liners, covers to be dark, dull colors.</li> <li>Sleeping bags used in snow have white exterior.</li> </ul>   | <ul style="list-style-type: none"> <li>Fasteners, components have dull, non-reflecting finish.</li> </ul>   | <ul style="list-style-type: none"> <li>Survival items brightly colored: life preserver, survival marker.</li> <li>Combat items have dull finish, non-reflecting surface.</li> <li>Light source dimmable for blackout or red lens provided.</li> </ul>   |
| will finish non-reflective, blind tags.  | <ul style="list-style-type: none"> <li>Preservative, special protective materials quickly, easily applied.</li> <li>Non-marking materials used for tents, tents.</li> <li>Cups, fasteners, buckles open, close silently.</li> <li>Combat footwear design details use to climb, crawl, run, perform other combat tasks with a minimum of slipping, pinching, rubbing.</li> <li>Boots are compatible with skin, snowshoes.</li> <li>Shoes, boots used around heavy equipment have rigid "heel" toe. Externally heated socks cannot shock wearers, especially after rest.</li> <li>Soles of boots, shoes are slip resistant.</li> </ul> | <ul style="list-style-type: none"> <li>Special protective clothing comfort micro-climate between 68°F @ 14 mm Hg H<sub>2</sub>O vapor pressure &amp; 95°F @ 3 mm Hg H<sub>2</sub>O vapor pressure.</li> <li>Protective clothing used in cold weather remains supple, does not stiffen.</li> <li>Fasteners open, close silently.</li> <li>Clothing is evaluated with full combat gear; does not degrade performance in any combat task due to lack of design, fit, comfort.</li> <li>If snugging, catching with jeopardize more velocity, snags either quick release fasteners used.</li> </ul> | <ul style="list-style-type: none"> <li>Bags easily turned inside-out for airing, cleaning.</li> <li>Bag liners provided for ease of cleaning.</li> <li>Air mattresses provided with easy-to-use patch kit.</li> <li>Bags have self-contained ties, straps.</li> <li>Zippers, fasteners operate quietly.</li> <li>Bags, mattress blankets are integrated with standard carrying device when rolled, packaged.</li> <li>Zippered bags have both internal, external zipper caps.</li> <li>Snapped bags have quick release capability.</li> <li>Snapping bags are designed to prevent any possibility of accidental suffocation.</li> </ul> | <ul style="list-style-type: none"> <li>One-man back-packed loads over 44 lb are provided with lifting aids for second man assist.</li> <li>Back-packs do not produce unbalanced loads, shoulder strain interference with walking, crawling, if under movement, body suspension regulation.</li> <li>Load permits freedom of movement; has no sharp edges, projections.</li> <li>Catches, snaps operate silently.</li> <li>Belts, straps easily replaced.</li> <li>Material milners, not, not proofed.</li> <li>Loads have a minimum of projections to prevent personnel injury or entanglement in undergrowth.</li> <li>Heavy load items have quick-release capability for duffing in emergency: drop water, attack, snugging, falling.</li> <li>Emergency supplies quickly accessed.</li> </ul>                                    | <ul style="list-style-type: none"> <li>Metal components not proofed, corrosion resistant.</li> <li>Replacement of expendable components done without tools: breathing canister, batteries.</li> <li>Leads, straps, chains, other noise producing elements are covered, anchored to reduce noise.</li> <li>Audible activation of fasteners, connectors is minimized.</li> <li>Equipment useable with helmet.</li> <li>Face plates, optics shatterproof.</li> <li>Sharp edges adequately covered during portage.</li> <li>Emergency items accessible at all times.</li> <li>Carrying, wearing these items does not interfere with required combat task performance: running, throwing, jumping, climbing, using weapons, crawling, wading.</li> <li>Eye, face coverings afford man vision, hearing to wearer.</li> <li>Preparation for use obvious: labeled.</li> <li>Special use instructions permanently attached.</li> </ul> |
| file with mil of matter with, provide protection, have no or have ventilation allow situated on objects is finger grip area. | <ul style="list-style-type: none"> <li>Core or use obvious, labeled or instructions included.</li> </ul>   | <ul style="list-style-type: none"> <li>Core or use obvious, labeled or instructions included.</li> </ul>   | <ul style="list-style-type: none"> <li>Core or use obvious, labeled or instructions included.</li> </ul>  | <ul style="list-style-type: none"> <li>Core or use obvious, labeled or instructions included on issue.</li> </ul>   |   |



# TEST FUNCTION

OBJECTIVE: Evaluate the item under test for its capacity to be effectively and safely assembled. The HFE subtest should consider evaluation of user performance or safety for this function under conditions representative of those expected in actual use.

## SELECT/PREPARE SITE

This is a necessary first step in the construction or erection of a large item. The technique and equipment for performing this task are, however, not a part of the primary test item.

The test engineer in this test situation would merely observe the site preparation operations to insure that the erection site is adequately prepared for the test item involved, in order to enable a valid test to be conducted. Caution should be exercised in that the time, equipment, and people available in a test situation may exceed that which will be available in a real use situation.

Some erection will be conducted in or on mud or sand, on slopes, and in inclement weather. The test should be conducted on terrain similar to that which will exist in the field. If it cannot, the test engineer will have to extrapolate to the predicted situation on the basis of (1) the test situation, (2) experience with similar structures, and (3) formal and informal data generated with regard to similar structures.

The items involved in these tasks are not a part of the test item. Material Handling Devices, Man Operated (Class III A) will account for most of the items used in these tasks. These items include such things as bulldozers, scoops, shovels, earth movers.

## PREPARE

## LAYOUT/INSPECT

PURPOSE: Evaluate the design of separate components of the test item for ease of handling, reliability of component identification, and ability of man to determine whether components are in satisfactory condition.

## MAN/ITEM TASKS

Unpackage/uncover components.

Move components into proper relationship to each other according to S.O.P./technical instructions.

Checkout structural integrity of components as well as status of moving/sliding parts.

PURPOSE: Evaluate the design of the test item for maximum assembly level, control of construction, test item work, which platforms.

## MAN/ITEM TASKS

Prepare component apply adhesive/sealant.

Join structural elements.

Insert/tighten fasteners.

Align structural parts.

## INDEX

|  | Test Item Components<br>HUMAN FACTORS<br>CONSIDERATIONS | Labels<br>Manuals<br>Markings<br>(1) | Test<br>Elements<br>Tools<br>(18) | Structural<br>Components<br>(29) | Labels<br>Manuals<br>Markings<br>(1) | F<br>C |
|--|---|--------------------------------------|-----------------------------------|----------------------------------|--------------------------------------|--------|
|  | A. LOCATION & ARRANGEMENT                               | A                                    | A                                 | A                                | A                                    |        |
|  | B. SIZE & SHAPE   | B                                    | B                                 | B                                | B                                    |        |
|  | C. DIRECTION & FORCE                                    |                                      | C                                 | C                                | C                                    |        |
|  | D. CLEARANCE  | D                                    | D                                 | D                                | D                                    |        |
|  | E. VISIBILITY   | E                                    | E                                 | E                                | E                                    |        |
|  | F. USE CONDITIONS                                       | F                                    | F                                 | F                                | F                                    |        |
|  | G. SAFETY   | G                                    | G                                 | G                                | G                                    |        |
|  | H. OPERATING PROCEDURES                                 | H                                    | H                                 | H                                | H                                    |        |



## ERECTABILITY

The conditions applicable to this class includes:

1. User conditions - body size, clothing and number of users;
2. Environmental conditions - weather, climate, terrain and illumination levels;
3. Operational conditions - use conditions (number of personnel, duration of use) and special hazards (height, wind, cold, ice).

## INDEX TO DETAILED DESIGN CONSIDERATIONS

[illegible]







## 18 DOLLAR WAYS, LOWS

the bodies of all universities and equipment such as laboratories, plants, power and security, filter bodies and crucibles.

29 SIXTH FLOOR COMMUNIST HEADQUARTERS

The primary characteristic of these components is that they are initially separate units that must be connected with other components to form sub-assemblies.

Includes such items as a single garden, a pre-assembled motorized unit, a door, a section of pipe, a tent, etc.

are used to control the flow of gas in the system. In the case of a gas leak, the gas will be released into the atmosphere.

to be heard at a  
distance.  
The lower elements  
intended toward ground  
and arranged to align  
themselves in the same  
direction that the upper  
elements.  
For operating just  
below  
the light beams provide  
thermal fuel.  
Large enough to be  
public conversion for  
up to, large heat  
and pure water  
oil.  
physically different  
a different is.

require the  
the French, the  
garden of Paris  
and, and, and  
to be one of the  
them one.  
the C.C. 10

Dimensions have  
Serator's staff, for  
evaluation to give  
to use correct  
for we're not  
available for  
with bare  
to have

Accession No.  
Numbered by Library  
Everything  
Date in connection  
This is given to the  
Public Distribution  
Under each open

Minimum connections:  
banding signals.  
As used where they  
are heard; covers  
several  
number of turns.  
As are used.  
A connection can be

...connecting  
connector does not  
age rating cannot be  
the receptacle of  
testing.  
are subject's  
to dust covers where  
only no other  
standard function, over

have, ears, should  
identify.  
as to voltage,  
receptacles iden-  
tity.  
have stripes, or  
aligning pin posi-  
tion above.  
rotating direction is  
identifications: f 10.

- Internal (internal) test points are of the jack (stand off) terminal design.
- Test points reflect the sequence for sequential testing.
- Test points for adjustment are close to the controls, displays used.
- Special tool is required for adjustment are with equipment.
- Test points are accessible.
- Test points, built-in meters used to indicate failed unit, module.

- \* Limiting body dimensions based on 5th % were for reaching test points: F10, P5, R1.
- \* Tables are long enough to check unit in place.
- \* Arms as hand hinged assays in working point on.

Calibration, adjustment controls with limited motion have mechanical stops to prevent damage. Stands, casters (wheels, hand-lift-mat) is provided for equipment exceeding 30 lb (10 kg).

Adequate storage provided in portable test equipment case, led to container leaks, probes, gauges, manometers, tanks.

Large parts are not mounted to derive access to smaller ones.

Sufficient space provided for test equipment, tool use without difficulty, hazard.

Indication of equipment power failure provided.

Display provided to show equipment out-of-tolerance, if true.

Test, adjustment, check point and cables, connectors, labels are accessible, visible during maintenance.

Non-visible screwdriver adjustments have mechanical shaft guide.

- Enough test points are provided to prevent removing sub-assemblies.
- Special tool use minimized.
- Knives preferred to screwdrivers for frequent adjustment.
- Tools provided with rings, eyes compatible with quick-release straps, hooks on tool belts.

- Electrical potentials over 500V are shopped down for test points.
- Tools, test leads used near high voltages are insulated.
- Electrical hand-held tools have 3-mv power with ground or are double insulated.
- Exposed surfaces of electrical hand-held tools are non-conducting or insulated.
- Contacts, terminals are shielded with suitable protective measures to prevent accidental contact.
- Test points permanently labeled, color-coded.
- Operating instructions for portable test equipment affixed to unit, lid or cover when used.
- Information reminder included with test equipment.
- Contacts, terminals, etc over 500V are clearly labeled.

Connection, lifting test points are easily reached before & after mating with other components.

- Component size, shape can also be determined by environments: jungle, slope, swamp, etc.
- Component shaped such that its connection method is obvious.

\* Weight limits for one man lift: FIG 1A.C.1; if shape is convenient, handles are provided, lift is not repeated, item is not carried.  
Horizontal push, pull force limits FIG 1A.C.2.  
Two-man lift values are twice one-man lift only lift item configuration convenient; neither man exceeds maximum limits.

Components are well spaced both during & after erection so that hand tools can be easily inserted, efficiently utilized. Clearance such that components can be removed, replaced quickly, easily. Components requiring replacement, adjustment, calibration are accessible during erection.

General assembly requirements min  
11-C: course, 30; medium, 50; fine,  
75; precise, 200.  
Blind attachments avoided whenever  
possible.

Operating, mechanical, electrical components are tested prior to assembly.

Preservatives, paint, greases applied to components do not hide cracks, breaks in structural members.

Non-sparking tools used in explosive atmosphere.

Sensitive, delicate components are protected against dust, rain, mud during assembly, erection.

Exposed edges (corners) rounded  
0.04" (0.5%).  
Sharp edges covered, sheathed for  
safe handling.  
Structural members used for climbing  
fit criteria for steps, ladders,  
platforms.  
If heights are involved: hooks, eyes  
are provided for attaching safety  
belts, lines.

Each assembly, component, part is labeled, identified.  
Items exceeding the one-man lift values are labeled with weight, lift limitation.  
or mechanical, power lift: hoist.  
Lift points provided, labeled.  
Sequence of assembly is clearly defined, accompanied by illustrations, diagrams.  
Connection, test points labeled.

- Design Requirements (MIL-STD-1472)
- User-Computer Interface Data (MIL-STD-1472C)
- Guidance Data (MIL-STD-1472D, Etc.)



# TEST FUNCTION

OBJECTIVE: Evaluate the design of tents, shelters or buildings to enable personnel to live, work and move about safely and effectively. The HFE subtest should consider personnel performance, comfort and safety for such functions as movement through the area and performing on-duty and off-duty activities. The evaluation should also assess these functions under conditions representative of those expected in actual use of this space.

| TRANSLATE/TRANSPORT   |  | PERFORM ON  |
|---|--|---|
| MOVE ABOUT  | TRANSPORT MATERIAL   |   |
| <p>PURPOSE: Evaluate the design of passageways, ladders, hatches, handholds, footholds to enable personnel to move through the area.</p> <p>MAN/ITEM TASKS</p> <p>Move through hallways.</p> <p>Climb ladders.</p> <p>Move through doors/hatches.</p> <p>Identify location.</p> | <p>PURPOSE: Evaluate the design of passageways, cargo transport devices, and hatches to enable personnel to move cargo through the area.</p> <p>MAN/ITEM TASKS</p> <p>Carry loads.</p> <p>Move loads using transport aid.</p> <p>Move loads to/from storage.</p> <p>Secure/unsecure loads.</p> <p>Monitor loads during transport.</p> <p>Read labels/warnings.</p> <p>Avoid obstacles.</p> | <p>PURPOSE: Evaluate working space for performed.</p> <p>MAN/ITEM TASKS</p> <p>Take position.</p> <p>Stow/unstow equip.</p> <p>Inspect station.</p> <p>Communicate.</p> <p>Move about the bus.</p> <p>Occupy work space.</p> <p>Control work space.</p> |

## INDEX TO DETAILED D

| Test Item Components<br>HUMAN FACTORS CONSIDERATIONS | Labels<br>Manuals<br>Markings<br>(1) | Steps<br>Ladders<br>Platforms<br>(2) | Handholds<br>Railings<br>(3) | Doors<br>Hatches<br>Passages<br>(4) | Labels<br>Manuals<br>Markings<br>(1) | Steps<br>Ladders<br>Platforms<br>(2) | Handholds<br>Railings<br>(3) | Doors<br>Hatches<br>Passages<br>(4) | Labels<br>Manuals<br>Markings<br>(1) | Workspace<br>(10) |
|--|--------------------------------------|--------------------------------------|------------------------------|-------------------------------------|--------------------------------------|--------------------------------------|------------------------------|-------------------------------------|--------------------------------------|-------------------|
| A. LOCATION & ARRANGEMENT                            | A                                    | A                                    | A                            | A                                   | A                                    | A                                    | A                            | A                                   | A                                    | A                 |
| B. SIZE & SHAPE                                      | B                                    | B                                    | B                            | B                                   | B                                    | B                                    | B                            | B                                   | B                                    | B                 |
| C. DIRECTION & FORCE                                 |                                      | C                                    |                              | C                                   |                                      | C                                    |                              | C                                   |                                      | C                 |
| D. CLEARANCE   | D                                    | D                                    | D                            | D                                   | D                                    | D                                    | D                            | D                                   | D                                    | D                 |
| E. VISIBILITY  | E                                    | E                                    | E                            | E                                   | E                                    | E                                    | E                            | E                                   | E                                    | E                 |
| F. USE CONDITIONS                                    | F                                    | F                                    | F                            | F                                   | F                                    | F                                    | F                            | F                                   | F                                    | F                 |
| G. SAFETY  | G                                    | G                                    | G                            | G                                   | G                                    | G                                    | G                            | G                                   | G                                    | G                 |
| H. OPERATING PROCEDURES                              | H                                    | H                                    | H                            | H                                   | H                                    | H                                    | H                            | H                                   | H                                    | H                 |



## HABITABILITY

e design of tents, shelters or buildings to  
e, work and move about safely and  
test should consider personnel perform-  
for such functions as movement through  
on-duty and off-duty activities. The  
stress these functions under conditions  
pected in actual use of this space.

The conditions applicable to this class include:

1. User conditions - body size, clothing and encumbrances
2. Environmental conditions - lighting, noise level and free volume
3. Operational conditions - blackout and emergency conditions.

|  | PERFORM ON-DUTY ACTIVITIES   | PERFORM OFF-DUTY ACTIVITIES   |   |
|--|--|---|---|
| SERIAL                                     | WORK   | PERFORM REST AND RELAXATION   | PERFORM LIFE ACTIVITIES   |
| design of post-devices, and<br>men to move | PURPOSE: Evaluate the design of the working space for supporting activities performed. | PURPOSE: Evaluate the design of R & R equipment and facilities of the building or area to accommodate these equipment and facilities. | PURPOSE: Evaluate the design of barracks and facilities for mess, waste disposal, bathing, self care, medical aid, and life supporting/sustaining environments. |
|  | MAN/ITEM TASKS   | MAN/ITEM TASKS  | MAN/ITEM TASKS  |
|  | Take position.   | Prepare area.   | Stow/unstow items.  |
| aid.                                       | Stow/unstow equipment.   | Stow/unstow equipment.  | Perform self care.  |
| .  | Inspect station.   | Control environment.  | Perform medical care.   |
|  | Communicate.   | Sleep/rest.   | Perform dental care.  |
| ert.                                       | Move about the building.   | Perform solitary activity.  | Perform eating.   |
|  | Occupy work space.   | Perform group activity.   | Perform waste elimination.  |
|  | Control work space environment.  |   | Modify area decor.  |

## INDEX TO DETAILED DESIGN CONSIDERATIONS

[illegible]



# FORMAL ACTION CORRECTIONS

## A. LOCATION/ACCESSIBILITY

The positioning of a component as it affects the ability of the operator to reach, use, or manipulate it, including location of openings (access, work, cover, etc.), location of controls, location of emergency (bibs, levers, etc.) as well as its relationship to other components.

## B. SIZE/SHAPE

The maximum and/or minimum dimensions of components that are required for adequate man use, including the effects of anthropometric and special clothing (arctic, PPE, etc.) on reach, and the physical nature of handles, knobs and other controls to ensure both the user's functional use of the component.

## C. DIRECTION/CONTROL

The movement and/or force required to operate or manipulate a component (handle, control, fastener, etc.), with emphasis on the direction of motion corresponding to the display, component, label item reaction or intended position as well as the minimum strength required.

## D. CLARITY

The unobstructed space surrounding a component which allows the operator to perform required actions, the sequence of which varies as a function of the amount of body movement (stand, crouch, sit, etc.), and, where appropriate, will also include considerations such as lighting, noise, helmets, protective clothing, etc.

## E. VISIBILITY

Those aspects of a component that contribute to the operator's ability to see it clearly, including location, size, shape, color, contrast, field of view, viewing distance, reflection, and illumination.

## F. USE/OPERATIONS

Those aspects of a component that pertain to its operational status before, during and after use, as well as the maintenance of an acceptable environment in the workspace areas.

## G. SAFETY

Those aspects of a component that could cause injury to the operator or other personnel, including preventative aspects for bad weather or related visibility, accidental contact with electrical, temperature, chemical, radiation and pressurization hazards, and danger to sight and hearing, particularly under the conditions of alert or battle stress.

## H. OPERATING PROCEDURES

Those operational and informational aspects affecting or improving man performance as found in equipment design documents as well as job aids, checklists, training texts, trouble-shooting guides, and repair manuals with due attention to the safety aspects of using the components.

Provide technical guidance in the form of written material, schematics, diagrams, illustrations and instruction sheets.

Give special guidance or instructions.

- Controls, displays, etc. are clearly, appropriately labeled except where use is obvious.
- Labels placed on or near items they identify.
- Do not cover other information.
- Label is not behind control.
- Label location consistent.
- Labels not obscured by components on flat feet surface on main chassis; min coverage by grilles not easily removed.

- Character height determined by distance read, minimum FIG 1.B.1.
- Group label characters larger than those of controls, displays which are larger than control, display position characters each by 25% min.
- Letter, numeral styles FIG 1.B.2.4.
- Height/width ratio: 5:3; "a" is 1 stroke width; "m" & "n" are 5/4; "i" & "l" are 1 stroke width.
- Stroke width for black (white) characters on light (black) backgrounds 1/16 (1/7-1/8) of height.

- Spacing between characters (words) one stroke (character) width min.
- Line spacing: 1/2 character height.
- Counter numeral row ratio = 1:1 (except 1); separation = 1/2 to 1/4 w.
- Optical projection: all caps, stroke width 1/16 to 1/8 h; exceeds 15 minutes visual angle.
- Thumbwheel numeral row ratio = 3:2; h = 5/8; stroke width internally (externally) illuminated = 10:1 (5:1).
- Abbreviations all caps, no periods.
- Extended copy uses lower case.
- Label characteristics determined by illumination level, color.
- Labels easily, accurately read at operational reading distance, vibration, light levels, environments.
- Labels are sharp with high or color contrast.

- With illumination above 1 ft-cd black letters, light background.
- Dark adaptations letters visible, do not interfere with night vision.
- Numbers, letters, details viewed by TV light on dark background.
- Label characteristics determined by required time available; distance; light level; color; criticality of function; consistency of design.
- Labels on production equipment are as durable as the equipment.
- Labels for prototype equipment easily of used, altered, removed.
- Labels not covered by other units nor obscured by grease, dirt.
- Markings, tags are as permanent, washable as equipment.
- Human numerals provided.
- Vertical labels used only when labels are not critical for personnel safety, performance.

- Electrical receptacles marked with voltage, phase, frequency.
- Pipe, hose, tube lines clearly labeled as to contents, pressure, temperature, hazards.
- Warning placards illuminated.
- Placards adjacent to hazards.
- Abbreviations are standard (MIL-STD-12); new OK if obvious.
- Trade names, irrelevant info do not appear on labeling.
- Labels concise; min redundancy.
- Words familiar to user.
- Print group items identified.
- Handed info directly usable; min of decoding, interpolation.

- Labels not obscured by components on flat feet surface on main chassis; min coverage by grilles not easily removed.
- Character height determined by distance read, minimum FIG 1.B.1.
- Group label characters larger than those of controls, displays which are larger than control, display position characters each by 25% min.
- Letter, numeral styles FIG 1.B.2.4.
- Height/width ratio: 5:3; "a" is 1 stroke width; "m" & "n" are 5/4; "i" & "l" are 1 stroke width.
- Stroke width for black (white) characters on light (black) backgrounds 1/16 (1/7-1/8) of height.

Provide a surface to accommodate user's feet while climbing or conducting routine checks and for the temporary placement of loads.

Wheels, hubs and structural members used for climbing are evaluated as ladders.

Angle of ascent: definition ladders, 75°-90°; stake ladders, 50°-75°; stairs, 20°-50°; ramps, 0°-20°; platforms, 0°.

- Sequence of stepping points ends with proper man orientation to door or entryways.
- Step surfaces within, without work-space easily reached from either direction.
- Fixed ladders between several levels offset at each succeeding level.
- Self locking device used on elevating stands, platforms.
- Simultaneous two-way traffic uses separate up, down ladders.

- Gross (limiting) dimensions based on 95th (5th%) body dimensions of users FIG 2.B.1.7.
- Stair, stair-ladder, fixed-ladder dimensions do not exceed the max. min dimensions FIG 2.B.1.1.
- Stairs, ladders accommodate 5th - 95th user wearing arctic clothing FIG 2.B.1.8.

- Folding ladder lift height: 5' max.
- One man limits to lift, store ladder: 5' for 20 lb; 6' for 25 lb.
- Stairs, ladders, platforms, ramps: withstand heaviest combined weight of user plus equipment plus safety factor.

- Finger clearance is provided in folding steps, ladders.
- Step width, spacing useable while wearing boots.
- Folding ladder catches, lock operable with cold/wet arctic mittens: FIG 2.B.1.1.
- Step width, spacing accommodate boots FIG 2.B.1.8.

- Stairway, illuminations: 10 ft-cd min.
- Visual obstructions, blind footholds avoided.
- Treads contrast with structure, conspicuous in dim light.
- For reduced lighting reflective materials used.

- Stair-ladders are of metal with the tread rise open at rear.
- Exterior personnel platforms, work areas: Open metal grating or non-skid surface.
- Steps useable if wet, icy.
- Rung ladders not used for frequent passage.
- 2-section extension ladders have captive hardware.
- Wheeled platforms have wheel locks.
- Provide access between areas.

- Ladders are not provided when equipment is to be hand carried.
- Open personnel platforms have a toe board, screen 3" h min.
- Elevators, hydraulic work platforms: control guards; limit stops fail-safe brakes guard rail, safety bars, chains.
- Safety mesh under open gratings.
- Obstructions, sharp edges are padded.
- Movable ladders non-slip feet.

- Elevators, hydraulic work platforms have visible max load signs.
- Footholds marked, identified.
- "No Step" markings if applicable.
- Warnings labels for hazards.
- Procedures listed for stowing, emptying ladders, ramps.

Assist users to mount and enter the item and to maintain balance.

Supply leverage and support to a climbing or working man.

Door handles, structural members, etc. used for gripping or balance, are evaluated as handholds.

- Handrails, safety bars, chains around platforms or step openings: 42" above standing surface.
- Handholds furnished where needed, within easy reach.
- Handholds integrated with doors, entryways for stability.
- Adequate handholds for balance while moving.
- Pedestrian ramps have handrails.

- Handrail dimensions: FIG 2.B.1.1.
- Handhold length: 6" min.
- Handhold opening: 6" x 4" min.

- Handholds do not intrude into work-space.
- Handhold accommodates arctic gloves FIG 2.B.1.1.

- Handholds clearly visible from inside and out prior to grasping.
- Color coded to enhance visibility, prevent grasping error.

- Stairs, stair-ladder, ramps open on one or both sides have intermediate guard rails.
- Stair-ladder handrails are non-slip.
- Handholds useable if wet, icy.
- Handgrip useable with bare hands in hot climates, high temp.
- Pedestrian ramps have handrails.
- Collapsible handholds useable while wearing arctic mittens.

- Open personnel platforms guardrails w/intermediate rails; top rail 42" min rails set back from edge 2" min.
- Handgrip areas away from cables, lines, hot pipes, other hazards.
- Inappropriate structures, wires cannot be used as handholds.
- Railings: no projections, snags.

- Handholds marked, identified.

Provide a means for entering and leaving the workspace.

Provide openings for loading or unloading material.

Components are evaluated for both normal and emergency use.

Some doors serve dual purpose and must also be evaluated as steps, ramps or platforms.

- Wall hatches flush with floor where structurally possible.
- Latch handles can be reached from normal approach position.
- Handgrips, footstaps help user reach hatch easily.
- Overhead hatches: latch to hold open inside padded; 1 hand operation.
- Handles can be reached, operated by troops in bulky clothing.

- Circular hatches: 30" min dia.
- Over hatches: 12" x 28" min.
- Trailer vans, portable shelters with one man use: 6' h, 30" w min.
- Passageway width: FIG 4.B.2.
- Doors: 80-84" h; 32-34" w.

- Match handle unlatching force: 20 lb max.
- Overhead hatches: opening force, 50 lb max; operable by user with 5th arm, hand strength: FIG 4.B.2.
- Match opening forces: 50 lb max.
- Handles operable with gloves.

- Fixed equipment is located 3" min from swept area of door.
- Gross (limiting) dimensions based on 95th (5th%) fully equipped users: FIG 2.B.1.7.
- Corridor width based on: peak load traffic flow; number, size of entrances.
- Wall escape hatches in vehicle mounted shelters clear all obstructions.
- Floor escape hatches: 22" min dia, 18" above ground.
- Passageway illuminations: 10 ft-cd min.

- Hatches open with a single motion of hand, foot.
- If "step down" through a top access exceeds 27", appropriate foot rests, toe boards, etc.
- Latch handles do not freeze up.
- Doors lockable from inside.
- Handles uniform in operation.
- Corridors have non-skid floors.

- Sliding doors are not installed as the only personnel exit.
- Doors, emergency exits are easily reached, unobstructed, quick opening: 3 sec max, 10-30 lb. operating force.
- Latch openings: smooth-edged, no obstructions, permit passage with survival equipment.
- Glass in doors shatterproof.
- No hazards or obstructions in entryways or on either side.

- Color of latch handle different from that of door.
- Correct movement of latch handle diagrammed, labeled.
- Exit instructions are legible, brief, clearly worded.
- Hallway boundaries clearly marked.

The area within which the equipment is located, space for equipment, electrical, etc. and windows on walls, consoles and units.

Provides storage for personal gear, weapons.

Provides space for equipment, storage space.

- Work space is height 6' 6"; seated, 29 1/2".
- Component design: must allow, guard to, etc.
- Desk tops, writing surfaces: 29 1/2" and min.
- Equipment designed: workspace requirements.

- Seats: sit, suitable for use without restraints.
- Arm rests: 28 1/2" min.
- Back, seat have 110° min.
- If van, air space: ceiling height 78" min.
- Vertical work surface: (24x48") and min.
- Standard console: 42" high (5th %).
- Gross (limiting) dimensions: 95th (5th %) fully equipped users: FIG 2.B.1.7.
- Adjustable dimensions.
- Vertical seat adjustment: max. 10" min.
- Seat, backrest recline: parts torso so user within 2° of level line.
- Seat adjusts fore, aft.
- Operator does not have to adjust seat.

- Equipment is located 3" min from swept area of door.
- Gross (limiting) dimensions based on 95th (5th%) fully equipped users: FIG 2.B.1.7.
- Corridor width based on: peak load traffic flow; number, size of entrances.
- Wall escape hatches in vehicle mounted shelters clear all obstructions.
- Floor escape hatches: 22" min dia, 18" above ground.
- Passageway illuminations: 10 ft-cd min.
- Hatches open with a single motion of hand, foot.
- If "step down" through a top access exceeds 27", appropriate foot rests, toe boards, etc.
- Latch handles do not freeze up.
- Doors lockable from inside.
- Handles uniform in operation.
- Corridors have non-skid floors.
- Sliding doors are not installed as the only personnel exit.
- Doors, emergency exits are easily reached, unobstructed, quick opening: 3 sec max, 10-30 lb. operating force.
- Latch openings: smooth-edged, no obstructions, permit passage with survival equipment.
- Glass in doors shatterproof.
- No hazards or obstructions in entryways or on either side.
- Color of latch handle different from that of door.
- Correct movement of latch handle diagrammed, labeled.
- Exit instructions are legible, brief, clearly worded.
- Hallway boundaries clearly marked.

- Handholds clearly visible from inside and out prior to grasping.
- Color coded to enhance visibility, prevent grasping error.

- Stair-ladders are of metal with the tread rise open at rear.
- Exterior personnel platforms, work areas: Open metal grating or non-skid surface.
- Steps useable if wet, icy.
- Rung ladders not used for frequent passage.
- 2-section extension ladders have captive hardware.
- Wheeled platforms have wheel locks.
- Provide access between areas.
- Ladders are not provided when equipment is to be hand carried.
- Open personnel platforms have a toe board, screen 3" h min.
- Elevators, hydraulic work platforms: control guards; limit stops fail-safe brakes guard rail, safety bars, chains.
- Safety mesh under open gratings.
- Obstructions, sharp edges are padded.
- Movable ladders non-slip feet.

- Elevators, hydraulic work platforms have visible max load signs.
- Footholds marked, identified.
- "No Step" markings if applicable.
- Warnings labels for hazards.
- Procedures listed for stowing, emptying ladders, ramps.

- Handholds marked, identified.

- Color of latch handle different from that of door.
- Correct movement of latch handle diagrammed, labeled.
- Exit instructions are legible, brief, clearly worded.
- Hallway boundaries clearly marked.

- Equipment is located 3" min from swept area of door.
- Gross (limiting) dimensions based on 95th (5th%) fully equipped users: FIG 2.B.1.7.
- Corridor width based on: peak load traffic flow; number, size of entrances.
- Wall escape hatches in vehicle mounted shelters clear all obstructions.
- Floor escape hatches: 22" min dia, 18" above ground.
- Passageway illuminations: 10 ft-cd min.
- Hatches open with a single motion of hand, foot.
- If "step down" through a top access exceeds 27", appropriate foot rests, toe boards, etc.
- Latch handles do not freeze up.
- Doors lockable from inside.
- Handles uniform in operation.
- Corridors have non-skid floors.
- Sliding doors are not installed as the only personnel exit.
- Doors, emergency exits are easily reached, unobstructed, quick opening: 3 sec max, 10-30 lb. operating force.
- Latch openings: smooth-edged, no obstructions, permit passage with survival equipment.
- Glass in doors shatterproof.
- No hazards or obstructions in entryways or on either side.
- Color of latch handle different from that of door.
- Correct movement of latch handle diagrammed, labeled.
- Exit instructions are legible, brief, clearly worded.
- Hallway boundaries clearly marked.

- Handholds clearly visible from inside and out prior to grasping.
- Color coded to enhance visibility, prevent grasping error.

- Stair-ladders are of metal with the tread rise open at rear.
- Exterior personnel platforms, work areas: Open metal grating or non-skid surface.
- Steps useable if wet, icy.
- Rung ladders not used for frequent passage.
- 2-section extension ladders have captive hardware.
- Wheeled platforms have wheel locks.
- Provide access between areas.
- Ladders are not provided when equipment is to be hand carried.
- Open personnel platforms have a toe board, screen 3" h min.
- Elevators, hydraulic work platforms: control guards; limit stops fail-safe brakes guard rail, safety bars, chains.
- Safety mesh under open gratings.
- Obstructions, sharp edges are padded.
- Movable ladders non-slip feet.

- Elevators, hydraulic work platforms have visible max load signs.
- Footholds marked, identified.
- "No Step" markings if applicable.
- Warnings labels for hazards.
- Procedures listed for stowing, emptying ladders, ramps.

- Handholds marked, identified.

- Color of latch handle different from that of door.
- Correct movement of latch handle diagrammed, labeled.
- Exit instructions are legible, brief, clearly worded.
- Hallway boundaries clearly marked.





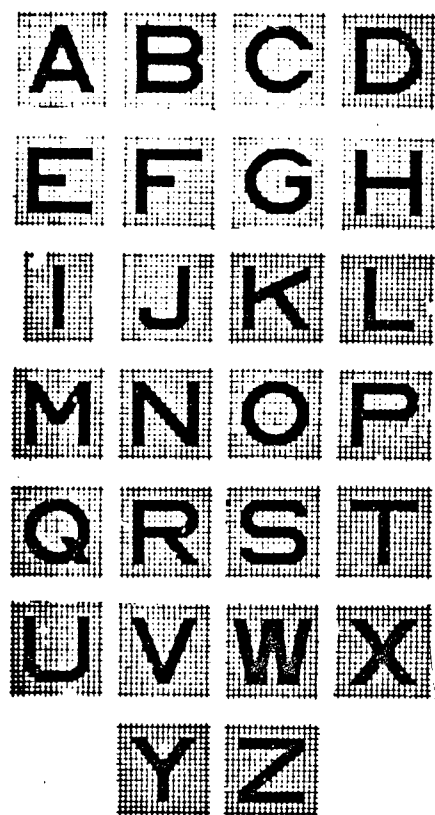


| MARKINGS   | HEIGHT*                                  |  |
|--|--|--|
|  | BELOW 1 ft-L<br>(3.5 cd/m <sup>2</sup> ) | ABOVE 1 ft-L<br>(3.5 cd/m <sup>2</sup> ) |
| FOR CRITICAL MARKINGS, WITH POSITION VARIABLE (e.g., NUMERALS ON COUNTERS AND SETTABLE OR MOVING SCALES):                              | 0.20 - 0.31 in.<br>(5 - 8 mm)            | 0.12 - 0.20 in.<br>(3 - 5 mm)            |
| FOR CRITICAL MARKINGS, WITH POSITION FIXED (e.g., NUMERALS ON FIXED SCALES, CONTROLS, AND SWITCH MARKINGS, OR EMERGENCY INSTRUCTIONS): | 0.16 - 0.31 in.<br>(4 - 8 mm)            | 0.10 - 0.20 in.<br>(2.5 - 5 mm)          |
| FOR NONCRITICAL MARKINGS (e.g., IDENTIFICATION LABELS, ROUTINE INSTRUCTIONS, OR MARKINGS REQUIRED ONLY FOR FAMILIARIZATION):           | 0.06 - 0.20 in.<br>(1.3 - 5 mm)          | 0.06 - 0.20 in.<br>(1.3 - 5 mm)          |

\* VALUES ASSUME A 26 in. (710 mm) VIEWING DISTANCE. FOR A DISTANCE, D, OTHER THAN 26 in. (710 mm) MULTIPLY THE ABOVE VALUES BY D/26 in. (D/710 mm).

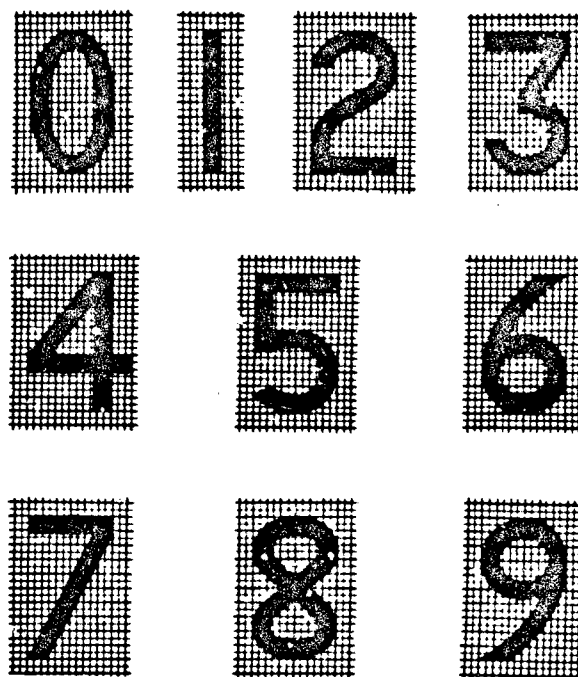
MIL-STD-1472

FIGURE 1.B.1 LABEL SIZE VERSUS LUMINANCE



MIL-M-18012

FIGURE 1.B.2 PREFERRED LETTER FONT



MIL-M-18012

FIGURE 1.B.3 PREFERRED NUMERICAL FONT



# FONTS FOR ENGRAVING

## LETTERS

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

GORTON EXTENDED

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

GORTON NORMAL

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

GORTON CONDENSED

## NUMBERS

1 2 3 4 5 6 7 8 9 0

GORTON EXTENDED

1 2 3 4 5 6 7 8 9 0

GORTON MODERNE

# FONTS FOR PRINTING

## LETTERS

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z  
 a b c d e f g h i j k l m n o p q r s t u v w x y z , ; : - ? ! " ' ( ) [ ] . \$ &

AIRPORT SEMIBOLD

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z  
 a b c d e f g h i j k l m n o p q r s t u v w x y z , ; : - ? ! " ' ( ) [ ] . \$ &

FUTURA DEMIBOLD

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z  
 a b c d e f g h i j k l m n o p q r s t u v w x y z , ; : - ? ! " ' ( ) [ ] . \$ &

VOGUE MEDIUM

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z  
 a b c d e f g h i j k l m n o p q r s t u v w x y z , ; : - ? ! " ' ( ) [ ] . \$ &

LINING GOTHIC No 66

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z  
 a b c d e f g h i j k l m n o p q r s t u v w x y z , ; : - ? ! " ' ( ) [ ] . \$ &

ALTERNATE GOTHIC No 3

## NUMBERS

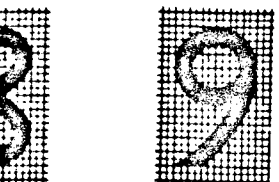
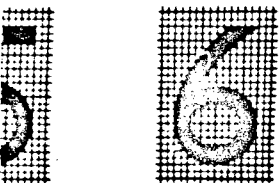
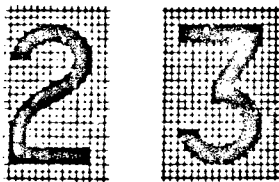
1 2 3 4 5 6 7 8 9

FUTURA MEDIUM

1 2 3 4 5 6 7 8 9

FUTURA TEMPO BOLD

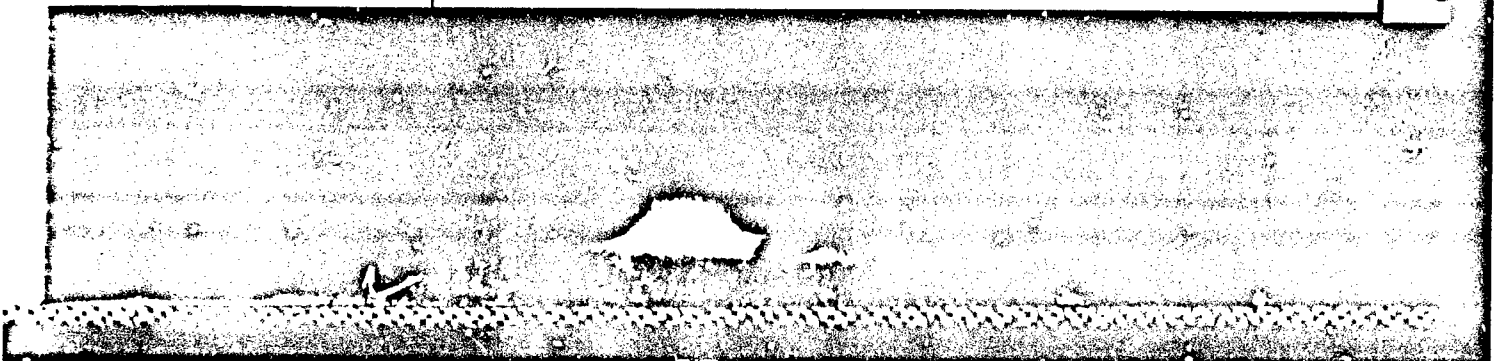
MIL-M-18012



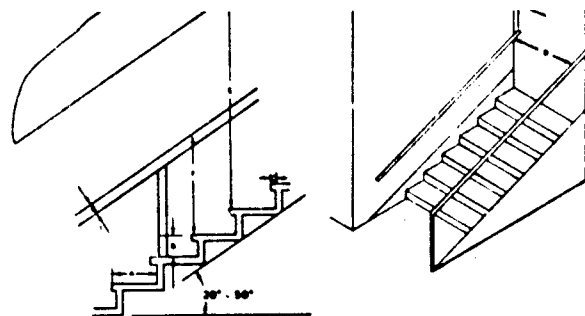
8012

TRED NUMERICAL FONT

FIGURE 1. B. 4 OTHER ACCEPTABLE FONTS



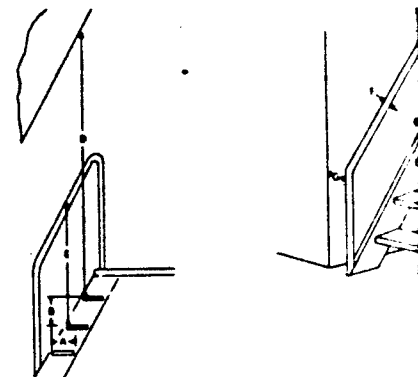




MIL-STD-1472

| DIMENSION   | MINIMUM          | MAXIMUM         | RECOMMENDED                 |
|---|------------------|-----------------|-----------------------------|
| A Tread depth (including nosing)                  | 9 5/8" (240mm)   | 12 0/8" (305mm) | 11 0/8" 12 0/8" (280-300mm) |
| B Riser height                                    | 5 0/8" (125mm)   | 6 0/8" (200mm)  | 5 5/8" 7 0/8" (166-188mm)   |
| C Depth of nosing (where applicable)              | 0 7/8" ( 25mm)   | 1 5/8" ( 38mm)  | 1 0/8" ( 25mm)              |
| D Width (handrail to handrail)                    |                  |                 |                             |
| One way stairs                                    | 36 0/8" (918mm)  | ...             | 36 0/8" (918mm)             |
| Two way stairs                                    | 48 0/8" (1220mm) | ...             | 51 0/8" (1300mm)            |
| E Overhead clearance                              | 76 0/8" (1920mm) | ...             | 78 0/8" (1980mm)            |
| F Height of handrail (from leading edge of tread) | 36 0/8" (918mm)  | 36 0/8" (918mm) | 33 0/8" (840mm)             |
| G Handrail diameter                               | 1 2/5" (32mm)    | 3 0/8" (75mm)   | 1 5/8" (38mm)               |
| H Rail clearance from wall                        | 1 7/8" (45mm)    | ...             | 3 0/8" (75mm)               |

FIGURE 2.B.1 STAIR DIMENSIONS

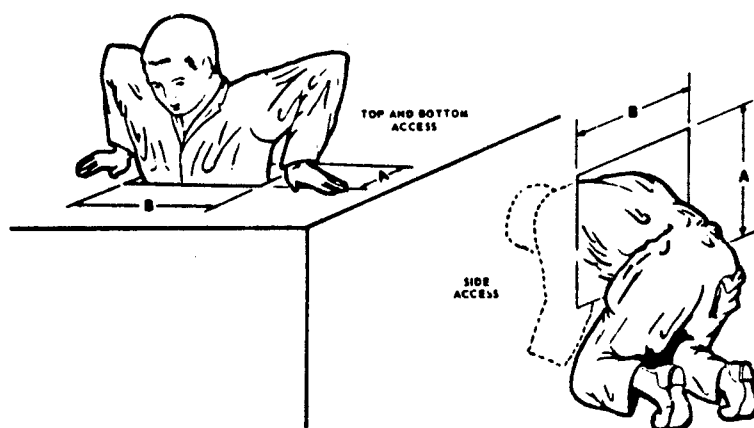


MIL-STD-1472

| DIMENSION   | MINIMUM            | MAXIMUM         |
|---|--------------------|-----------------|
| A Tread depth ramps                               |                    |                 |
| For 50° rise                                      | 6 0/8" (150mm)     | 10 0/8" (250mm) |
| For 75° rise (open leaders only)                  | 3 0/8" (75mm)      | 5 5/8" (140mm)  |
| B Riser height                                    | 7 0/8" (180mm)     | 12 0/8" (300mm) |
| C Width (handrail to handrail)                    | 21 0/8" (530mm)    | 24 0/8" (610mm) |
| D Overhead clearance                              | * 68 0/8" (1720mm) |                 |
| E Height of handrail (from leading edge of tread) | 34 0/8" (860mm)    | 37 0/8" (940mm) |
| F Handrail diameter                               | 1 2/5" (32mm)      | 2 0/8" (50mm)   |
| G Rail clearance from wall                        | 2 0/8" (50mm)      |                 |

\*Whenever the distance D is less than 74 0/8" (1880 mm), the overhead clearance shall be yellow and black stripes.

FIGURE 2.B.2 STAIR-LADDER DIMENSIONS



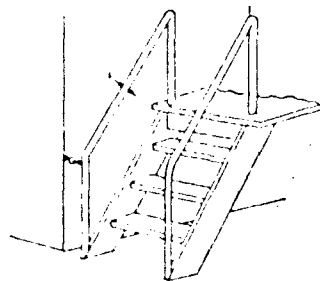
MIL-STD-1472

| DIMENSIONS            | A. DEPTH    |             | B. WIDTH    |             |
|-----------------------|-------------|-------------|-------------|-------------|
| CLOTHING              | LIGHT       | BULKY       | LIGHT       | BULKY       |
| TOP AND BOTTOM ACCESS | 12" (300mm) | 18" (460mm) | 23" (580mm) | 27" (680mm) |
| SIDE ACCESS           | 26" (660mm) | 28" (710mm) | 30" (760mm) | 34" (860mm) |

NOTE: DIMENSIONS SHOWN BASED ON MALE DATA.

FIGURE 4.B.1 WHOLE BODY ACCESS OPENING



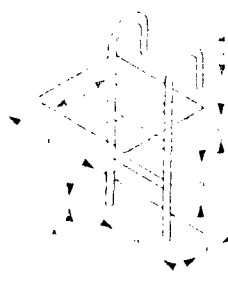


[MIL-STD-1472]

|           | MINIMUM          | MAXIMUM          | RECOMMENDED      |
|-----------|------------------|------------------|------------------|
| width     | 6'00" (1830mm)   | 10'00" (3048mm)  | 8'50" (2591mm)   |
| depth     | 3'00" (914mm)    | 5'50" (1676mm)   | 4'00" (1219mm)   |
| height    | 7'00" (2134mm)   | 12'00" (3658mm)  | 9'00" (2743mm)   |
| clearance | 21'00" (6401mm)  | 24'00" (7315mm)  | 22'00" (6706mm)  |
| clearance | *6'00" (1830mm)  |                  | 7'60" (2317mm)   |
| clearance | 34'00" (10400mm) | 37'00" (11281mm) | 35'00" (10668mm) |
| clearance | 1'25" (39mm)     | 3'00" (914mm)    | 1'50" (559mm)    |
| clearance | 2'00" (610mm)    |                  | 3'00" (914mm)    |

If clearance is less than 74'50" (22710mm), the overhead obstruction should be painted black.

RE 2.B.2 STAIR-LADDER DIMENSIONS



[MIL-STD-1472]

| DIMENSION                                    | MINIMUM           | MAXIMUM  | RECOMMENDED            |
|--|-------------------|--|------------------------|
| A RUNG THICKNESS                             |                   |  |                        |
| WOOD   | 1 1/8 in. (32 mm) | 1 1/2 in. (38 mm)                                  | 1 3/8 in. (35 mm)      |
| PROTECTED METAL                              | 3/4 in. (19 mm)   | 1 1/2 in. (38 mm)                                  | 1 3/8 in. (35 mm)      |
| COMPOSITE METAL                              | 1 in. (25 mm)     | 1 1/2 in. (38 mm)                                  | 1 1/8 in. (35 mm)      |
| B RUNG SPACING                               | 9 in. (230 mm)    | 15 in. (380 mm)                                    | 12 in. (300 mm)        |
| C HEIGHT RUNG TO LANDING                     | 8 in. (150 mm)    | 15 in. (380 mm)                                    | 15 in. (380 mm)        |
| D WIDTH BETWEEN STRINGERS                    | 12 in. (300 mm)   |  | 18 21 in. (460-529 mm) |
| E CLIMBING CLEARANCE WIDTH                   | 24 in. (610 mm)   |  | 30 in. (760 mm)        |
| F CLEARANCE DEPTH                            |                   |  |                        |
| F IN BACK OF LADDER                          | 6 in. (150 mm)    |  | 8 in. (200 mm)         |
| G ON CLIMBING SIDE (RANGE)                   |                   | 36 in. (910 mm) for 75° to 30 in. (760 mm) for 90° |                        |
| H HEIGHT OF STRINGER ABOVE LANDING           | 33 in. (840 mm)   |  | 36 in. (910 mm)        |
| J HEIGHT FROM LOWER ELEVATION TO BOTTOM RUNG |                   | 15 in. (380 mm)                                    |                        |

\*For male use exclusively use 16'00" (4877mm)

FIGURE 2.B.3 FIXED-LADDER DIMENSIONS

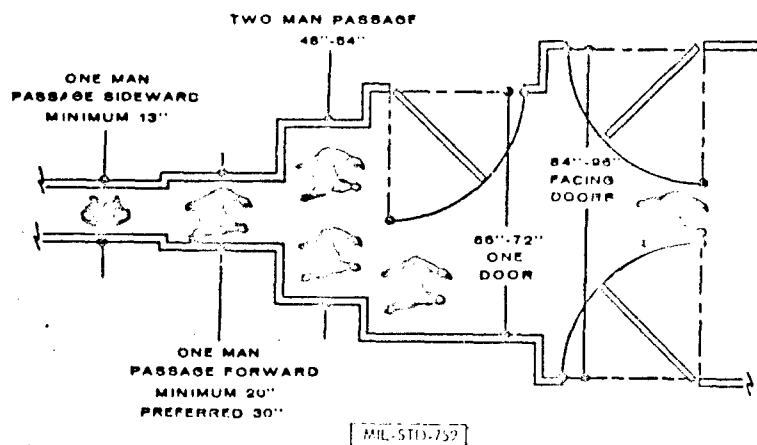
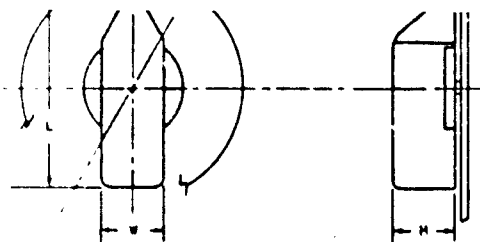


FIGURE 4.B.2 WALKWAY AND PASSAGEWAY DIMENSIONS



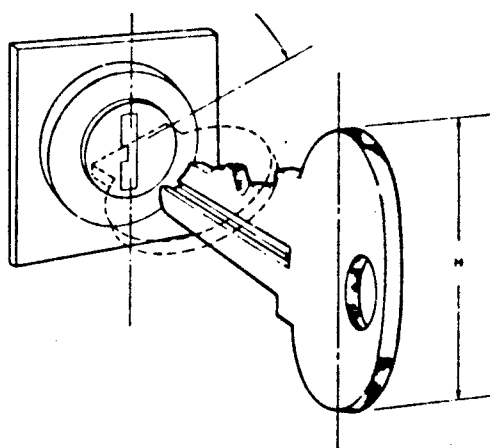


MIL-STD-1472

|           | DIMENSIONS     |               |                    | REFERENCE             |
|-----------|----------------|---------------|--------------------|-----------------------|
|           | L<br>LENGTH    | W<br>WIDTH    | H<br>DEPTH         |                       |
| MINIMUM   | 1 in. (25 mm)  |               | 7/8 in. (19 mm)    | 1 in. 4b (115mm) m    |
| MAXIMUM   | 4 1/4 (108 mm) | 1 in. (25 mm) | 3 in. (75 mm)      | 6 in. 4b (600 mm) m   |
|           | DISPLACEMENT   |               | SEPARATION         |                       |
|           | A              |               | ONE-HAND<br>RANDOM | TWO-HAND<br>OPERATION |
| MINIMUM   | 15° (262 mm)   | 30° (50 mm)   | 1 in. (25 mm)      | 3 in. (75 mm)         |
| MAXIMUM   | 40° (700 mm)   | 60° (1570 mm) | —                  | —                     |
| PREFERRED | —              | —             | 2 in. (50 mm)      | 6 in. (150 mm)        |

\* WHEN SPECIAL ENGINEERING REQUIREMENTS DEMAND LARGE SEPARATION OR WHEN  
TACTUALLY (BLIND) POSITIONED CONTROLS ARE REQUIRED

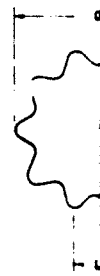
### FIGURE 6.B.1 ROTARY SELECTOR SWITCH



MIL STD-1472

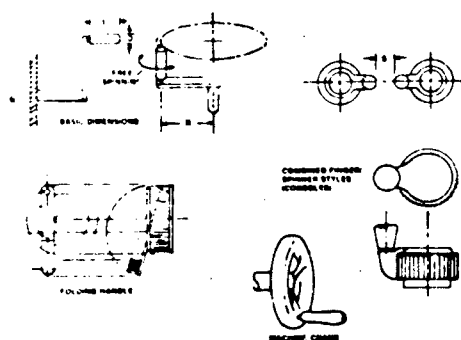
|         | DISPLACEMENT<br>(A) | HEIGHT<br>(H)      | RESISTANCE               |
|---------|---------------------|--------------------|--------------------------|
| MINIMUM | 30°<br>(525 mrad)   | 1/2 in.<br>(13 mm) | 1 in.-lb.<br>(115 mN-cm) |
| MAXIMUM | 90°<br>(1578 mrad)  | 3 in.<br>(75 mm)   | 6 in.-lb.<br>(680 mN-cm) |

**FIGURE 6.B.2 KEY-OPERATED SWITCH**



**FIGURE 6**

|         |               |
|---------|---------------|
|         | DIAS          |
| MINIMUM | 1 1/2<br>(30) |
| MAXIMUM | 3 1/2<br>(75) |



MIL-STD-1472

| LOAD   | SPECIFICATION                   | HANDLE    |     |             |    | P TURNING RINGS    |     |                    |     |
|--|---------------------------------|-----------|-----|-------------|----|--------------------|-----|--------------------|-----|
|  |                                 | L. LENGTH |     | D. DIAMETER |    | RATE BELOW 100 RPM |     | RATE ABOVE 100 RPM |     |
|  |                                 | IN        | MM  | IN          | MM | IN                 | MM  | IN                 | MM  |
| LIGHT LOADS<br>Less Than 5 lb.<br>22 N/turn and<br>finger movement | MINIMUM<br>PREFERRED<br>MAXIMUM | 1         | 25  | 3/8         | 10 | 1 1/2              | 38  | 1/2                | 13  |
|  |                                 | 1 1/2     | 38  | 1 1/2       | 13 | 3                  | 75  | 2 1/2              | 60  |
|  |                                 | 3         | 75  | 3/4         | 19 | 5                  | 125 | 6 1/2              | 175 |
| HEAVY LOADS<br>More Than 5 lb.<br>22 N/turn<br>(no finger-mvt)     | MINIMUM<br>PREFERRED<br>MAXIMUM | 3         | 75  | 1           | 25 | 7 1/2              | 190 | 5                  | 125 |
|  |                                 | 3 3/4     | 95  | 1           | 25 | ...                | ... | ...                | ... |
|  |                                 | ...       | ... | 1 1/2       | 38 | 30                 | 510 | 9                  | 230 |

3 SEPARATION BETWEEN ADJACENT CONTROLS 3" (76 mm) 000000-0000

### FIGURE 6.B.5 CRANKS

[illegible]

ML-STD-1472

[illegible]

### FIGURE 6.B.6 HANDWHEELS



ML-STD-1478

|             |                       |
|-------------|-----------------------|
|             | 2<br>P. 2<br>F. 20500 |
| MAXIMUM USE | 1" -<br>(25 mm)       |
| MAXIMUM USE | 4" -<br>(100 mm)      |

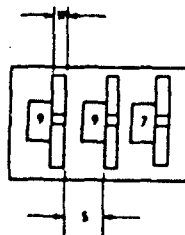
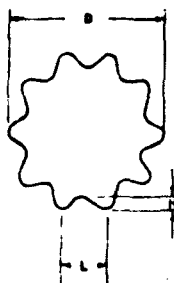
\* PREFERRED SOME NEW

**FIGURE 8.6**





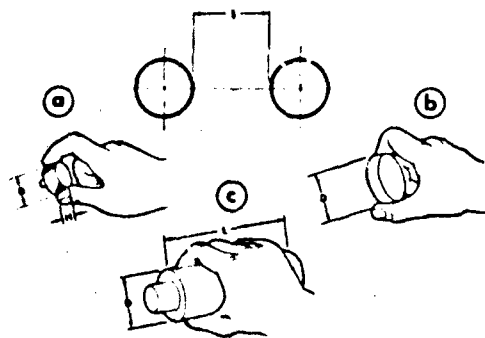
ANCE  
40-40  
40-40



MIL-STD-1472

|         | D<br>DIAMETER       | L<br>LENGTH         | W<br>WIDTH        | H<br>HEIGHT       | S<br>SEPARATION        | RESISTANCE      |
|---------|---------------------|---------------------|-------------------|-------------------|------------------------|-----------------|
| MINIMUM | 1.40 in.<br>(36 mm) | 7/16 in.<br>(11 mm) | 1/8 in.<br>(3 mm) | 1/8 in.<br>(3 mm) | 1.000 in.<br>(25.4 mm) | 0.05<br>(1.7 N) |
| MAXIMUM | 3 in.<br>(75 mm)    | 3/4 in.<br>(19 mm)  | 1/4 in.<br>(6 mm) | 1/4 in.<br>(6 mm) | 1.000 in.<br>(25.4 mm) | 30.0<br>(8.5 N) |

FIGURE 6.B.3 DISCRETE THUMBWHEEL CONTROL



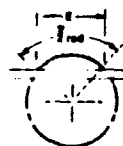
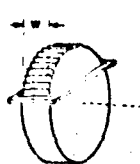
MIL-STD-1472

| DIMENSIONS |                           |                            |                            |                               |              |
|------------|---------------------------|----------------------------|----------------------------|-------------------------------|--------------|
|            | Fingert Grip              | Thumb and Finger Encircled | Palm Grip                  |                               |              |
|            | H<br>Height               | D<br>Diameter              | D<br>Diameter              | D<br>Diameter                 | L<br>Length  |
| MINIMUM    | 0.5" (13 mm)              | 0.375" (9.5 mm)            | 1.0" (25 mm)               | 1.5" (38 mm)                  | 3.0" (76 mm) |
| MAXIMUM    | 1.0" (25 mm)              | 0.8" (20 mm)               | 3.0" (76 mm)               | 3.0" (76 mm)                  | 3.0" (76 mm) |
| TORQUE     |                           |                            | SEPARATION                 |                               |              |
|            |                           |                            | S<br>One Hand Individually | S<br>Two Hands Simultaneously |              |
| MINIMUM    |                           |                            | 1.0" (25 mm)               | 2.0" (50 mm)                  |              |
| MAXIMUM    | 4.5 in. oz.<br>(127 mN-m) | 8.0 in. oz.<br>(202 mN-m)  | 2.0" (50 mm)               | 3.0" (76 mm)                  |              |

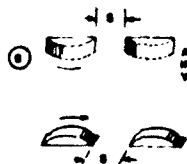
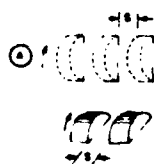
\* To and including 1.0 in. (25 mm) diameter knobs  
\*\* Greater than 1.0 in. (25 mm) diameter knobs

FIGURE 6.B.4 CONTINUOUS ADJUSTMENT ROTARY CONTROL KNOBS

MIL-STD-1472



CONTINUOUS SETTING



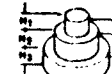
ARROWS INDICATE INCREASING VALUE

|         | E<br>EXPOSURE | W<br>WIDTH   | S<br>SEPARATION                           |   | RESISTANCE   |
|---------|---------------|--------------|---|---|--|
|         |               |              | (A)                                       | (B)                                     |  |
| MINIMUM | 1" (25 mm)    | 1/8" (3 mm)  | 1" (25 mm)<br>ADD 1/2" (13 mm) FOR GLOVES | 2" (50 mm)<br>ADD 1" (25 mm) FOR GLOVES | TO MINIMIZE EFFECTS OF INADVERTENT INPUT IF OPERATOR SUBJECT TO MOTION |
| MAXIMUM | 6" (150 mm)   | 7/8" (22 mm) | N/A                                       | N/A                                     | 2.5 N (12 oz.)   |

\* PREFERRED SOME MINIMUM APPLICATIONS MAY REQUIRE LESS

FIGURE 6.B.7 THUMBWHEEL ADJUSTMENT CONTROLS

MIL-STD-1472



GANGED KNOB/SHOULDER ASSOCIATION

| DIMENSIONS                    |                          |                |                |                |                               |                |                          |                |                |                |
|-------------------------------|--------------------------|----------------|----------------|----------------|-------------------------------|----------------|--------------------------|----------------|----------------|----------------|
| TWO KNOB ASSEMBLY (PREFERRED) |                          |                |                |                | THREE KNOB ASSEMBLY (MAXIMUM) |                |                          |                |                |                |
|                               | H <sub>1</sub>           | H <sub>2</sub> | D <sub>1</sub> | D <sub>2</sub> | H <sub>1</sub>                | H <sub>2</sub> | H <sub>3</sub>           | D <sub>1</sub> | D <sub>2</sub> | D <sub>3</sub> |
| MINIMUM                       | 0.5" (13 mm)             | 1/2" (13 mm)   | 1/2" (13 mm)   | 1/2" (13 mm)   | 1/2" (13 mm)                  | 1/2" (13 mm)   | 1/2" (13 mm)             | 1/2" (13 mm)   | 1/2" (13 mm)   | 1/2" (13 mm)   |
| MAXIMUM                       | 1.0" (25 mm)             | 1.0" (25 mm)   | 1.0" (25 mm)   | 1.0" (25 mm)   | 1.0" (25 mm)                  | 1.0" (25 mm)   | 1.0" (25 mm)             | 1.0" (25 mm)   | 1.0" (25 mm)   | 1.0" (25 mm)   |
| TORQUE                        |                          |                |                |                | SEPARATION                    |                |                          |                |                |                |
|                               |                          |                |                |                | ONE HAND INDIVIDUALLY         |                | TWO HANDS SIMULTANEOUSLY |                |                |                |
|                               |                          |                |                |                | SAFE                          | GLOVED         | SAFE                     | GLOVED         | SAFE           | GLOVED         |
| MINIMUM                       |                          |                |                |                | 1" (25 mm)                    | 3 1/2" (89 mm) | 2" (50 mm)               | 3 1/2" (89 mm) | 2" (50 mm)     | 3 1/2" (89 mm) |
| MAXIMUM                       | 22 in. oz.<br>(557 mN-m) |                |                |                | 2" (50 mm)                    | 3 1/2" (89 mm) | 2" (50 mm)               | 3 1/2" (89 mm) | 2" (50 mm)     | 3 1/2" (89 mm) |

\* TO AND INCLUDING 1" (25 mm) DIAMETER KNOBS  
\*\* GREATER THAN 1" (25 mm) DIAMETER KNOBS

FIGURE 6.B.8 GANGED KNOBS



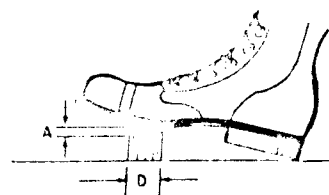


MIL-STD-1472

| MINIMUM      |                | RESISTANCE               |                   |                   |               |
|--------------|----------------|--------------------------|-------------------|-------------------|---------------|
| STROKE       |                | THUMB OR PALM            | SINGLE FINGER     | DIFFERENT FINGERS | THUMB OR PALM |
| MINIMUM      | 5/16 in (8 mm) | 3/4 in (19 mm)           | 2.8 N (10 oz)     | 1.8 N (5 oz)      | 2.8 N (10 oz) |
| MAXIMUM      | 1/2 in (13 mm) | 1 in (25 mm)             | 11 N (40 oz)      | 5.6 N (20 oz)     | 23 N (80 oz)  |
| DISPLACEMENT |                |                          |                   |                   |               |
| FINGER TIP   |                | THUMB OR PALM            |                   |                   |               |
| MINIMUM      | 5/16 in (8 mm) | 1/8 in (3 mm)            |                   |                   |               |
| MAXIMUM      | 1/2 in (13 mm) | 1 1/2 in (38 mm)         |                   |                   |               |
| OPERATION    |                |                          |                   |                   |               |
|              |                | SINGLE FINGER SEQUENTIAL | DIFFERENT FINGERS | THUMB OR PALM     |               |
| MINIMUM      | 1/2 in (13 mm) | 1/4 in (6 mm)            | 1/8 in (3 mm)     | 1/4 in (6 mm)     |               |
| PREFERRED    | 2/3 in (16 mm) | 1/2 in (13 mm)           | 1/2 in (13 mm)    | 8/32 in (16 mm)   |               |

NOTE: AN ALTERNATE BARTHAND APPLICATION FOR GLOVED HAND OPERATION MINIMA SHOULD BE CONSIDERED.

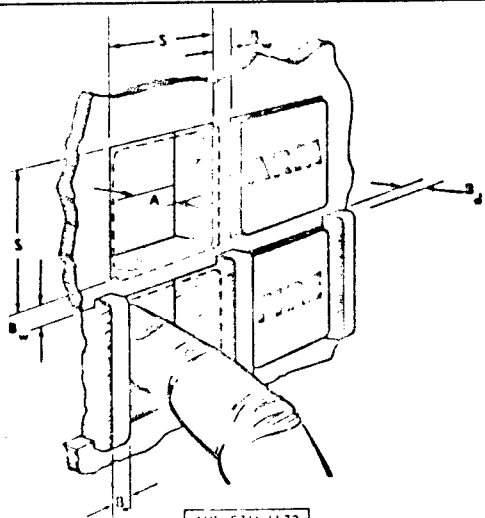
FIGURE 6.B.9 PUSHBUTTONS (FINGER OR HAND OPERATED)



MIL-STD-1472

|         | DIAMETER<br>D | RESISTANCE                    |                           | DISPLACEMENT     |                      |                    |                    |
|---------|---------------|-------------------------------|---------------------------|------------------|----------------------|--------------------|--------------------|
|         |               | Foot Will Not Rest On Control | Foot Will Rest On Control | Normal Operation | Heavy Boot Operation | Ankle Flexion Only | Total Leg Movement |
| Minimum | 0.50" (13mm)  | 40 lb (18N)                   | 100 lb (45N)              | 0.50" (13mm)     | 1.0" (25mm)          | 1.0" (25mm)        | 1.0" (25mm)        |
| Maximum |               | 200 lb (90N)                  | 200 lb (90N)              | 2.5" (65mm)      | 2.5" (65mm)          | 2.5" (65mm)        | 4.0" (100mm)       |

FIGURE 6.B.10 PUSHBUTTONS (FOOT OPERATED)



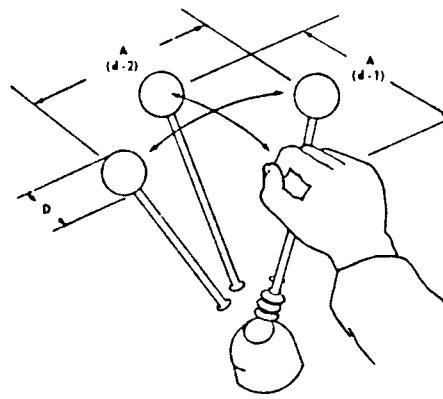
MIL-STD-1472

|         | S<br>STROKE      | A<br>DISPLACEMENT | BARRIERS <sup>1</sup> |                  | RESISTANCE    |
|---------|------------------|-------------------|-----------------------|------------------|---------------|
|         |                  |                   | B <sub>1</sub>        | B <sub>2</sub>   |               |
| MINIMUM | 3/8 in (10 mm)   | 1/8 in (3 mm)     | 1/8 in (3 mm)         | 5/16 in (8 mm)   | 10 N (2.5 lb) |
| MAXIMUM | 1 1/2 in (38 mm) | 1/4 in (6 mm)     | 1/4 in (6 mm)         | 1 1/4 in (30 mm) | 40 N (9 lb)   |

<sup>1</sup> BARRIERS SHALL HAVE ROUNDED EDGES.  
<sup>2</sup> 3/8 IN IS MINIMUM POSITIVE POSITION SWITCHES.  
<sup>3</sup> 1 1/2 IN IS MAXIMUM FOR USE IN MOVING VEHICLES.

NOTE: B<sub>2</sub> ALSO REFERS TO SWITCH SEPARATION.

FIGURE 6.B.13 LEGEND SWITCH



MIL-STD-1472

|              | DIAMETER         |                 | RESISTANCE     |                       |                |
|--------------|------------------|-----------------|----------------|-----------------------|----------------|
|              | FINGER GRASP     | HAND GRASP      | ONE HAND (d-1) | TWO HANDS             | ONE HAND (d-2) |
| MINIMUM      | 1/2 in (13 mm)   | 1/2 in (38 mm)  | 2 lb (9 N)     | 2 lb (9 N)            | 2 lb (9 N)     |
| MAXIMUM      | 1 1/2 in (38 mm) | 3 in (75 mm)    | 30 lb (135 N)  | 50 lb (220 N)         | 20 lb (90 N)   |
| DISPLACEMENT |                  |                 |                |                       |                |
|              |                  | FORWARD (d-1)   | LATERAL (d-2)  | SEPARATION            |                |
|              |                  | ONE HAND RANDOM |                | TWO HAND SIMULTANEOUS |                |
| MINIMUM      |                  | 2 in (50 mm)    |                | 3 in (75 mm)          |                |
| PREFERRED    |                  | 4 in (100 mm)   |                | 5 in (125 mm)         |                |
| MAXIMUM      |                  | 14 in (360 mm)  |                | 18 in (460 mm)        |                |

FIGURE 6.B.14 LEVER



| ELEMENT            |                    |
|--------------------|--------------------|
| Ankle Flexion Only | Total Leg Movement |
| 1.0" (25mm)        | 1.0" (25mm)        |
| 2.5" (63mm)        | 4.0" (100mm)       |

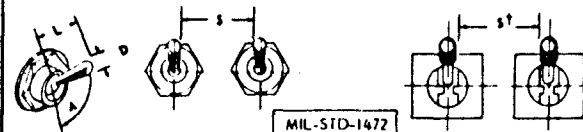
|           | Dimensions<br>Diameter<br>D* |                 | Resistance    |                             |               |
|-----------|------------------------------|-----------------|---------------|-----------------------------|---------------|
|           | Bare-handed                  | Arche-montage** | Numeric       | Alpha-numeric               | Dual Function |
|           | Minimum<br>0.396"            | 0.75"           | 3.5 oz        | 9.9 oz                      | 9.9 oz        |
| Maximum   | 0.75"                        |                 | 14.0 oz       | 5.3 oz                      | 5.3 oz        |
| Preferred | 0.6"                         | 0.75"           |               |                             |               |
|           | Displacement                 |                 | Separation    |                             |               |
|           | Numeric                      | Alpha-numeric   | Dual Function | (between adjacent key tops) |               |
|           | Minimum<br>0.03"             | 0.05"           | 0.03"         | 0.25"                       |               |
| Maximum   | 0.19"                        | 0.25"           | 0.19"         |                             |               |
| Preferred |                              |                 |               | 0.25"                       |               |

|           | Dimensions<br>Diameter<br>D* |                 | Resistance    |                             |               |
|-----------|------------------------------|-----------------|---------------|-----------------------------|---------------|
|           | Bare-handed                  | Arche-montage** | Numeric       | Alpha-numeric               | Dual Function |
|           | Minimum<br>10mm              | 18mm            | 1N            | 250 mN                      | 250 mN        |
| Maximum   | 18mm                         |                 | 4N            | 1.5 N                       | 1.5 N         |
| Preferred | 13mm                         | 18mm            |               |                             |               |
|           | Displacement                 |                 | Separation    |                             |               |
|           | Numeric                      | Alpha-numeric   | Dual Function | (between adjacent key tops) |               |
|           | Minimum<br>0.8mm             | 1.3mm           | 0.8mm         | 6.4mm                       |               |
| Maximum   | 4.8mm                        | 6.3mm           | 4.8mm         |                             |               |
| Preferred |                              |                 |               | 6.4mm                       |               |

\*See Figure 6.B.7  
\*\*Trigger finger type

MIL-STD-1472

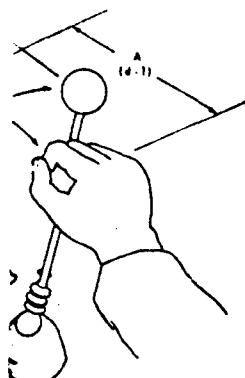
FIGURE 6.B.11 KEYBOARDS



|                                | DIMENSIONS                 |                                      | RESISTANCE                                  |               |
|--------------------------------|----------------------------|--------------------------------------|---|---------------|
|                                | ARM LENGTH                 | D CONTROL TIP                        | SMALL SWITCH                                | LARGE SWITCH  |
|                                | MINIMUM<br>1/2 in (13 mm)  | 1-1/2 in (38 mm)                     | 16 oz (2.8 N)                               | 16 oz (2.8 N) |
| MAXIMUM                        | 2 in (50 mm)               | 2 in (50 mm)                         | 16 oz (4.5 N)                               | 40 oz (11 N)  |
| DISPLACEMENT BETWEEN POSITIONS |                            |                                      |   |               |
|                                | 2 POSITIONS                |                                      | 3 POSITIONS                                 |               |
|                                | MINIMUM<br>30° (525 mrad)  |                                      | 17° (295 mrad)                              |               |
|                                | MAXIMUM<br>80° (1400 mrad) |                                      | 45° (790 mrad)                              |               |
| DESIRED                        | ...                        |                                      | 25° (430 mrad)                              |               |
|                                | SEPARATION                 |                                      |   |               |
|                                | SINGLE FINGER OPERATION    | S SINGLE FINGER SEQUENTIAL OPERATION | SIMULTANEOUS OPERATION BY DIFFERENT FINGERS |               |
|                                | MINIMUM<br>3/4 in (19 mm)  | 1 in (25 mm)                         | 1/2 in (13 mm)                              |               |
| OPTIMUM                        | 2 in (50 mm)               | 2 in (50 mm)                         | 1 in (25 mm)                                |               |

\*USE BY BARE FINGER \*\*USE WITH HEAVY HANDWEAR †USING A LEVER LOCK TOGGLE SWITCH

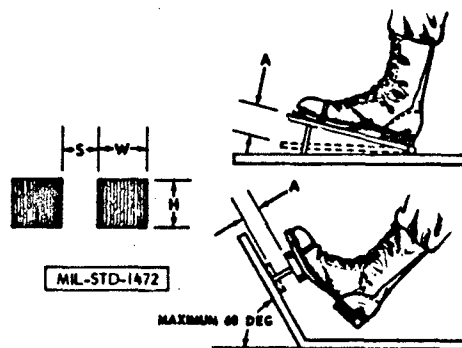
FIGURE 6.B.12 TOGGLE SWITCHES



MIL-STD-1472

| RESISTANCE      |               |                          |                 |
|-----------------|---------------|--------------------------|-----------------|
| (M 1)           | TWO HANDS     | ONE HAND                 | (M 2) TWO HANDS |
|                 | 2 lb (9 N)    | 2 lb (9 N)               | 2 lb (9 N)      |
|                 | 50 lb (220 N) | 20 lb (90 N)             | 30 lb (135 N)   |
| SEPARATION      |               |                          |                 |
| ONE HAND RANDOM |               | TWO HANDS SIMULTANEOUSLY |                 |
| 2 in (50 mm)    |               | 3 in (75 mm)             |                 |
| 4 in (100 mm)   |               | 5 in (125 mm)            |                 |

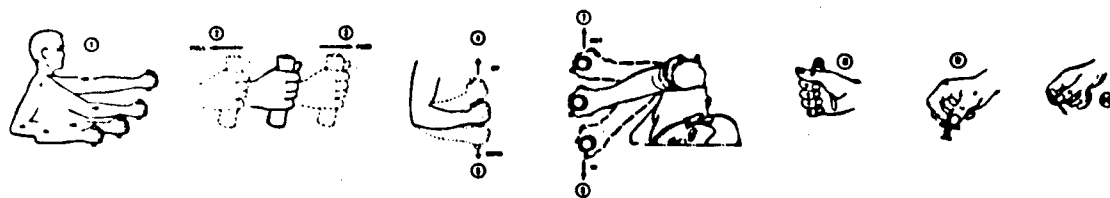
6.B.14 LEVER



|            | DIMENSIONS                   |             | DISPLACEMENT             |                       |                     |                       |
|------------|------------------------------|-------------|--------------------------|-----------------------|---------------------|-----------------------|
|            | H                            | W           | Normal<br>Operation      | Heavy<br>Boots        | Ankle<br>Flexion    | Total Leg<br>Movement |
|            | Height                       | Width       |                          |                       |                     |                       |
| Minimum    | 1.8" (45mm)                  | 3.5" (75mm) | 8.5" (13mm)              | 1.8" (45mm)           | 1.8" (45mm)         | 1.8" (45mm)           |
| Maximum    | -                            | -           | 2.5" (65mm)              | 2.5" (65mm)           | 2.5" (65mm)         | 7.8" (195mm)          |
| RESISTANCE |                              |             |                          |                       |                     |                       |
|            | Foot Not Resting<br>on Pedal |             | Foot Resting<br>on Pedal | Ankle<br>Flexion Only |                     | Total Leg<br>Movement |
|            | 4 lb (18N)                   |             | 10 lb (45N)              | -                     |                     | 10 lb (45N)           |
|            | 20 lb (90N)                  |             | 20 lb (90N)              | 10 lb (45N)           |                     | 100 lb (2000N)        |
| SEPARATION |                              |             |                          |                       |                     |                       |
|            | One Foot Random              |             |                          | 5                     | One Foot Sequential |                       |
|            | 4.8" (100mm)                 |             |                          |                       | 2.8" (50mm)         |                       |
|            | 6.8" (160mm)                 |             |                          |                       | 4.8" (100mm)        |                       |
| Minimum    | 4.8" (100mm)                 |             |                          |                       | 2.8" (50mm)         |                       |
| Preferred  | 6.8" (160mm)                 |             |                          |                       | 4.8" (100mm)        |                       |

FIGURE 6.B.15 PEDALS





MIL-STD-1472

| ARM STRENGTH (Lb)             |      |    |      |    |     |    |      |    |     |    |     |    |  |
|-------------------------------|------|----|------|----|-----|----|------|----|-----|----|-----|----|--|
| (1)                           | (2)  |    | (3)  |    | (4) |    | (5)  |    | (6) |    | (7) |    |  |
| DEGREE OF ELBOW FLEXION (deg) | PULL |    | PUSH |    | UP  |    | DOWN |    | IN  |    | OUT |    |  |
|                               | L    | R* | L    | R  | L   | R  | L    | R  | L   | R  | L   | R  |  |
| 100                           | 56   | 52 | 42   | 50 | 9   | 14 | 12   | 17 | 13  | 20 | 8   | 14 |  |
| 150                           | 42   | 56 | 30   | 42 | 15  | 10 | 10   | 20 | 15  | 20 | 8   | 16 |  |
| 120                           | 34   | 42 | 26   | 36 | 17  | 24 | 21   | 26 | 22  | 10 | 10  | 16 |  |
| 90                            | 27   | 17 | 22   | 34 | 17  | 20 | 21   | 20 | 10  | 10 | 10  | 10 |  |
| 60                            | 16   | 24 | 22   | 34 | 15  | 20 | 10   | 20 | 17  | 20 | 12  | 17 |  |

| HAND AND THUMB-FINGER STRENGTH (Lb) |           |    |                          |    |                          |    |                          |    |                          |    |                          |    |  |
|-------------------------------------|-----------|----|--------------------------|----|--------------------------|----|--------------------------|----|--------------------------|----|--------------------------|----|--|
|                                     | (8)       |    | (9)                      |    | (10)                     |    | (11)                     |    | (12)                     |    | (13)                     |    |  |
|                                     | HAND GRIP |    | THUMB-FINGER GRIP (PALM) |    | THUMB-FINGER GRIP (TYPE) |    | THUMB-FINGER GRIP (TYPE) |    | THUMB-FINGER GRIP (TYPE) |    | THUMB-FINGER GRIP (TYPE) |    |  |
|                                     | L         | R  | L                        | R  | L                        | R  | L                        | R  | L                        | R  | L                        | R  |  |
| MOMENTARY HOLD                      | 56        | 50 | 13                       | 13 | 13                       | 13 | 13                       | 13 | 13                       | 13 | 13                       | 13 |  |
| SUSTAINED HOLD                      | 33        | 30 | 8                        | 8  | 8                        | 8  | 8                        | 8  | 8                        | 8  | 8                        | 8  |  |

\* L - LEFT, R - RIGHT

FIGURE 6. C. 1 ARM, HAND, AND THUMB-FINGER STRENGTH (5th PERCENTILE MALE DATA)

MIL-STD-1472

| ARM STRENGTH (IN)                   |           |     |                            |     |                          |     |                          |     |                          |    |                          |    |  |
|-------------------------------------|-----------|-----|----------------------------|-----|--------------------------|-----|--------------------------|-----|--------------------------|----|--------------------------|----|--|
| (1)                                 | (2)       |     | (3)                        |     | (4)                      |     | (5)                      |     | (6)                      |    | (7)                      |    |  |
| DEGREE OF ELBOW FLEXION (deg)       | PULL      |     | PUSH                       |     | UP                       |     | DOWN                     |     | IN                       |    | OUT                      |    |  |
|                                     | L         | R*  | L                          | R   | L                        | R   | L                        | R   | L                        | R  | L                        | R  |  |
| #                                   | 222       | 231 | 167                        | 222 | 40                       | 62  | 60                       | 76  | 50                       | 60 | 30                       | 62 |  |
| 90 #                                | 167       | 240 | 123                        | 167 | 67                       | 80  | 80                       | 80  | 67                       | 80 | 30                       | 67 |  |
| 120 #                               | 161       | 167 | 116                        | 160 | 70                       | 107 | 80                       | 116 | 80                       | 80 | 40                       | 67 |  |
| 150 #                               | 142       | 160 | 80                         | 160 | 70                       | 80  | 80                       | 116 | 71                       | 80 | 45                       | 71 |  |
| 180 #                               | 116       | 167 | 80                         | 161 | 67                       | 80  | 80                       | 80  | 70                       | 80 | 50                       | 70 |  |
| HAND AND THUMB-FINGER STRENGTH (IN) |           |     |                            |     |                          |     |                          |     |                          |    |                          |    |  |
|                                     | (8)       |     | (9)                        |     | (10)                     |     | (11)                     |     | (12)                     |    | (13)                     |    |  |
|                                     | HAND GRIP |     | THUMB-FINGER GRIP (PALMER) |     | THUMB-FINGER GRIP (TYPE) |     | THUMB-FINGER GRIP (TYPE) |     | THUMB-FINGER GRIP (TYPE) |    | THUMB-FINGER GRIP (TYPE) |    |  |
|                                     | L         | R   | L                          | R   | L                        | R   | L                        | R   | L                        | R  | L                        | R  |  |
| MOMENTARY HOLD                      | 200       | 200 | 60                         | 60  | 60                       | 60  | 60                       | 60  | 60                       | 60 | 60                       | 60 |  |
| SUSTAINED HOLD                      | 140       | 150 | 30                         | 30  | 30                       | 30  | 30                       | 30  | 30                       | 30 | 30                       | 30 |  |

\* ELBOW ANGLE SHOWN IN RADIANS

\*\* L - LEFT, R - RIGHT

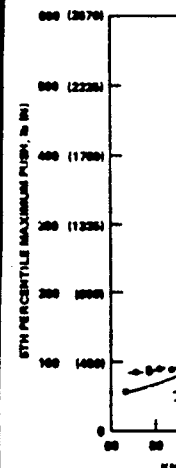


FIGURE 6. C. 2 LEG

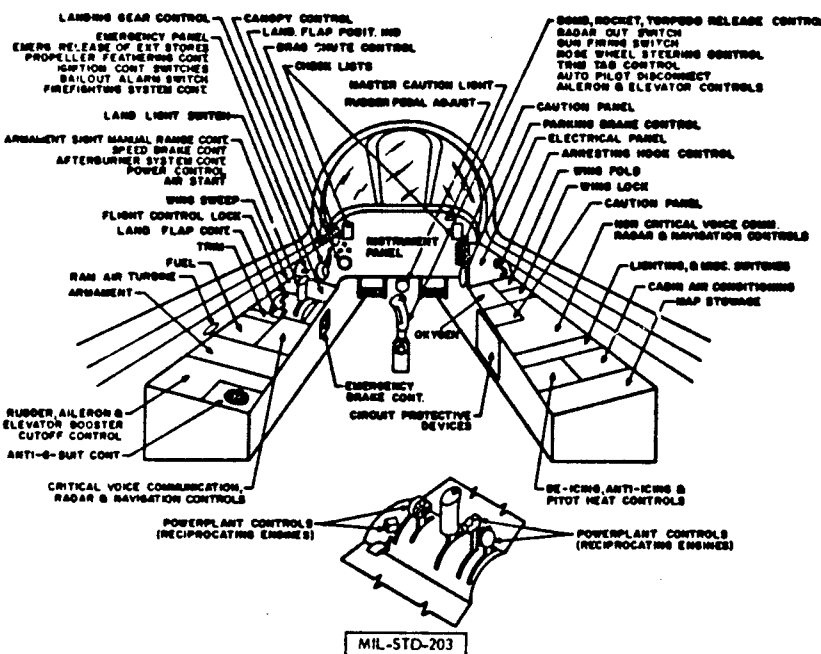


FIGURE 7. A. 1 SINGLE PILOT-TANDEM PILOT EQUIPMENT ARRANGEMENT

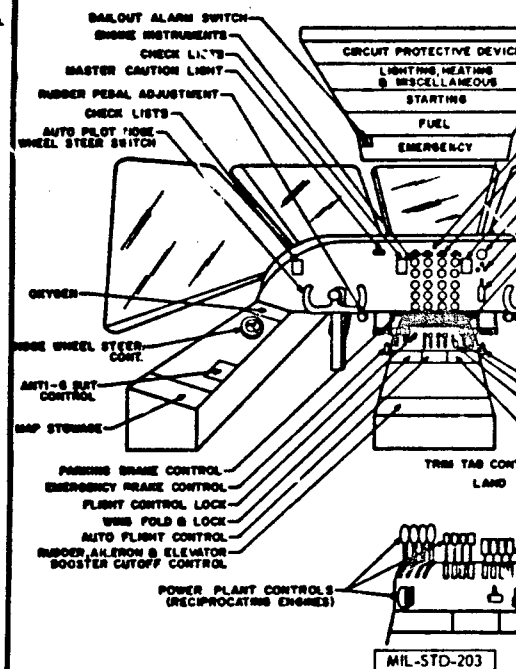


FIGURE 7. A. 2 SIDE-BY-SIDE PILOT EQUIPMENT ARRANGEMENT



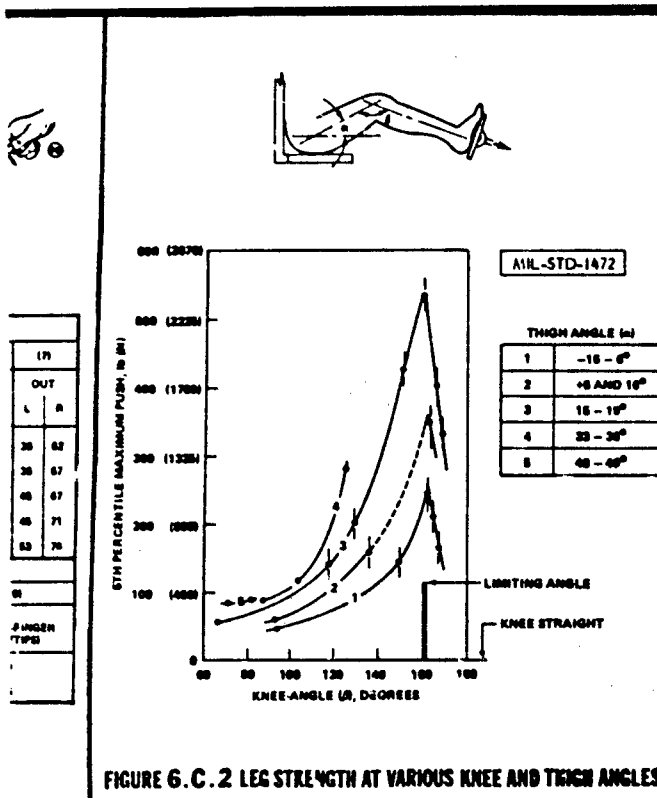


FIGURE 6.C.2 LEG STRENGTH AT VARIOUS KNEE AND THIGH ANGLES

**MIL-STD-1472**

| FUNCTION | CONTROL ACTION                              |
|----------|---|
| ON       | UP, RIGHT, FORWARD, CLOCKWISE, PULL         |
| OFF      | DOWN LEFT, REARWARD, COUNTERCLOCKWISE, PUSH |
| RIGHT    | CLOCKWISE, RIGHT                            |
| LEFT     | COUNTERCLOCKWISE, LEFT                      |
| RAISE    | UP  |
| LOWER    | DOWN  |
| RETRACT  | UP, REARWARD, PUSH                          |
| EXTEND   | DOWN, FORWARD, PUSH                         |
| INCREASE | FORWARD, UP, RIGHT, CLOCKWISE               |
| DECREASE | REARWARD, DOWN, LEFT, COUNTERCLOCKWISE      |

FIGURE 6.C.3 CONVENTIONAL CONTROL MOVEMENTS

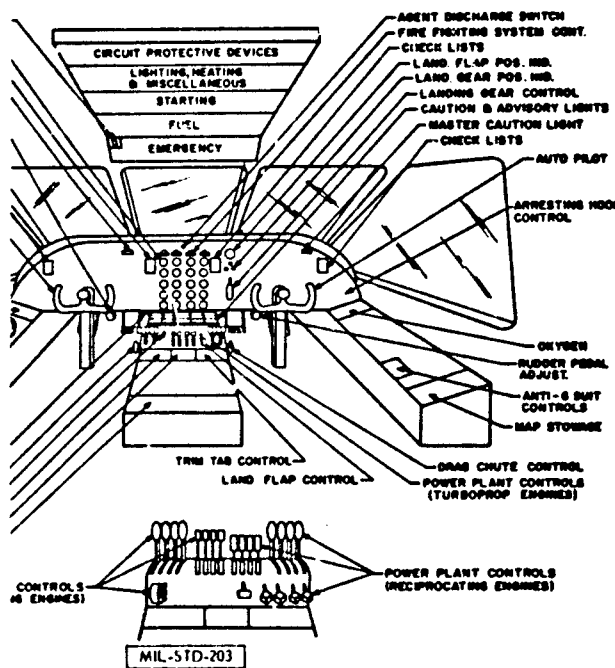
|                              | TOGGLE SWITCHES | *PUSH-BUTTONS | CONTINUOUS ROTARY CONTROLS | ROTARY SELECTOR SWITCHES | DISCRETE THUMBWHEEL CONTROLS |
|------------------------------|-----------------|---------------|----------------------------|--------------------------|------------------------------|
| TOGGLE SWITCHES              | FIG 6.B.10      | 0.5"(13 mm)   | 0.75"(19 mm)               | 0.75"(19 mm)             | 0.5"(13 mm)                  |
| *PUSH-BUTTONS                | 0.5"(13 mm)     | FIG 6.B.7     | 0.5"(13 mm)                | 0.5"(13 mm)              | 0.5"(13 mm)                  |
| CONTINUOUS ROTARY CONTROLS   | 0.75"(19 mm)    | 0.5"(13 mm)   | FIG 6.B.4                  | 1.0"(25 mm)              | 0.75"(19 mm)                 |
| ROTARY SELECTOR SWITCHES     | 0.75"(19 mm)    | 0.5"(13 mm)   | 1.0"(25 mm)                | FIG 6.B.1                | 0.75"(19 mm)                 |
| DISCRETE THUMBWHEEL CONTROLS | 0.5"(13 mm)     | 0.5"(13 mm)   | 0.75"(19 mm)               | 0.75"(19 mm)             | FIG 6.B.3                    |

\*For pushbuttons not separated by barriers

All values are for one hand operation. Distances are measured in inches and are measured from edge to edge of each control.

**MIL-STD-1472**

FIGURE 6.D.1 MINIMUM SEPARATION DISTANCES FOR CONTROLS



A. 2 SIDE-BY-SIDE PILOT EQUIPMENT ARRANGEMENT

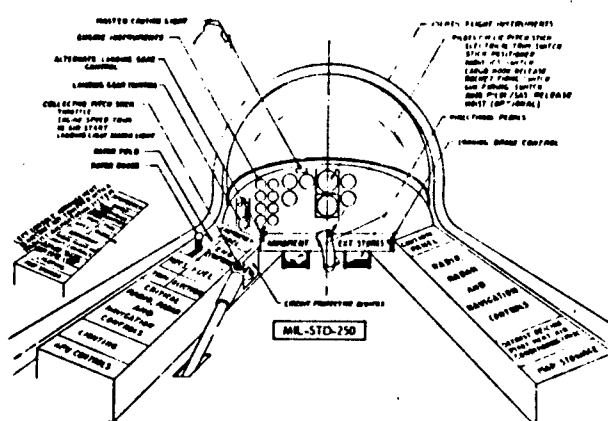


FIGURE 7.A.3 SINGLE PILOT-TANDEM PILOT EQUIPMENT ARRANGEMENT IN AIRCRAFT EQUIPPED WITH A STABILITY AUGMENTATION SYSTEM





| CONTROL   | ACTION  |
|---|---|
| Rudder  | Conventional*   |
| Rudder Pedal Adjustment                                   | Motion to extend pedals is clockwise, push or lift conventional                             |
| Aileron and Elevator                                      | Conventional  |
| Rudder, Aileron, Elevator Booster                         | Performance related   |
| Flight Control Lock                                       | Restricts throttles   |
| Autopilot   | Conventional  |
| Rudder, Aileron, Elevator Trim                            | Conventional  |
| Landing Gear  | Conventional  |
| Landing Flaps   | Conventional  |
| Speed Brake   | Aft motion for braking  |
| Tail Wheel Lock   | Upward or forward or both for lock  |
| Arresting Hook  | Normal: Motion corresponds to hook movement<br>Emergency: Push button or hook shaped switch |
| Wing Folding  | Forward or outboard to spread; aft or inboard to fold                                       |
| Wing Locking  | Forward or outboard to lock, aft or inboard to unlock                                       |
| Wing Sweep  | Conventional  |
| Wheel Brake   | Conventional  |
| Parking Brake   | Pull to actuate; push pedals to release   |
| Emergency Brake   | Pull to apply   |
| Canopy  | Forward or down to close, aft or up to open   |
| Canopy Jettison   | Conventional  |
| Nose Wheel Steering                                       | Conventional, push button to engage   |
| Thermal Cockpit Closure                                   | Positive action latches for open, intermediate, closed                                      |
| Drag Chute  | Handle: pull to deploy (non-rotatable); rotate either way to jettison                       |
| Launch Bar  | Forward to extend; aft to retract   |
| Power:  |   |
| Reciprocating   | Standard  |
| Turbo-prop  | Performance related   |
| Turbojet  | Performance related   |
| Reverse Thrust: Shaft Power                               | Motion aft through a stop that employs a "lift to reverse" type of control mechanism        |
| Turbojet  | Aft motion  |
| Fluid Injection Systems                                   | Performance related   |
| Afterburner   | Automatically actuated by power control   |
| Super or Turbocharger Assisted Takeoff                    | Forward or up for low blower<br>Performance related   |
| Cowl Flaps, Inter-coolers, Oil Coolers, etc.              | Forward, upward or clockwise for increased cooling  |
| Carburetor Heat Air Filter, Alternate Air and Turbobypass | Performance related   |



| ITEM   | COMMENTS  | CONTROL  | ACTUATION  | COMMENTS  |
|--|---|--|--|---|
| ational*   |   | Induction System                                     | Performance related  |   |
| n to extend pedals in clock-<br>push or lift conventional              |   | Anti-icing   |  |   |
| ational  |   | Fuel system selector                                 | Conventional   | "Off" position is protected by a safety device/ If fuel is supplied from several tanks, a diagrammatic fuel system is provided around the selector(s)                     |
| ance related   |   |  |  |   |
| icts throttles   |   | Fuel system  | Conventional   |   |
| ational  | Electrical disconnect on stick or manual control on autopilot   | Ignition Switch(es):<br>Reciprocating                | Clockwise rotation produces the following sequence: "Off", "Left", "Right", "Both" | Switches are separated electrically and mechanically  |
| atio al  | Inadvertent action guarded against/ Position and range of adjustment indicated/ Only wheel, knob or switch used (not crank)                           | Turboprop or jet                                     | Performance related  | If switch is not integral with power lever, it functions as an ignition arming switch   |
| ation l  | Proper knob shape/ Handle light illuminates when gear is inconsistent with handle position/ Labeled   | Air Start Switch(es)                                 | Performance related  |   |
| ntional  |   | Propeller Feathering                                 | Push to feather  | A light is provided to indicate power failure or feathering action  |
| otion for braking  |   | Vector Thrust  | Aft movement changes direction downward to vertical                                |   |
| for forward or both for  |   | Ram Air Turbine                                      | Pull to release  |   |
| Motion corresponds to movement   |   | Firefighting System                                  | Pull to actuate  | A single control for each engine or critical area plus one agent discharge switch/ Control knob illuminates when that system is actuated/ Control knob is of proper shape |
| ncys: Push button or hook switch                                       |   | Master Electrical                                    | Conventional   |   |
| id or outboard to spread; aft ward to fold                             |   | Lighting and Miscellaneous                           | Performance related  | For carrier aircraft, a master exterior light switch is near the throttle   |
| id or outboard to lock; aft ward to unlock                             |   | Landing Light and Searchlight                        | Performance related  |   |
| ntional  |   | Circuit Breakers                                     | Conventional   | Only those which affect the safety of the flight need be accessible   |
| ntional  | With dual brakes, simultaneous braking is possible  | Primary Voice Communications and Intercommunications | Performance related  | Primary communications transmitter switch is on the power lever for control wheel for side-by-side pilots)  |
| to actuate; push pedals to   |   | Navigation   | Performance related  |   |
| o apply  |   | Radar Identification                                 | Performance related  |   |
| o or down to close, aft or open  |   | Armament-General                                     | Performance related  |   |
| ntional  |   | Guns and Associated Items:                           |  |   |
| ational, push button to  |   | Gun Firing   | Squeeze to fire  |   |
| ve action latches for open, mediate, closed                            |   | Armament Sight                                       | Turn clockwise or press for closing range  |   |
| to pull to deploy (non-able); rotate either way to son                 |   | Manual Range   | Performance related  |   |
| id to extend; aft to retract   |   | Radar Out  | Performance related  |   |
| ird  | Power controls arranged left-to-right: throttle(s); propeller control(s) (shorter than throttle); mixture control(s) (shorter than propeller control) | Gun Charging   | As marked  |   |
| ance related   |   | Bomb, Rocket, Torpedo and External Stores:           |  |   |
| ance related   |   | Normal Release                                       | Press to release or fire preselected components                                    |   |
| raft through a stop that is a "lift to reverse" type control mechanism |   | Emergency Release                                    | Master electrical jettisoning: push to release                                     |   |
| otion  |   |  | Mechanical release: pull to release  | Guarded plunger type switch in addition to electrical jettisoning switch  |
| ance related   |   | Anti-G Suit  | Performance related  |   |
| itically actuated by power   |   | Cabin Air Conditioning                               | Conventional   |   |
| id or up for low blower  |   | Shoulder Harness                                     | Forward to lock  |   |
| ance related   |   | Seat Adjustment                                      | Movement corresponds to seat motion  |   |
| id, upward or clockwise for med cooling                                |   | Deicing and Anti-icing and Pitot Heat                | Performance related  |   |
| ance related   |   | Bail-out Alarm                                       | Conventional   | Appropriately guarded   |

MIL-STD-203

\* Conventional indicates all controls are actuated in accordance with established custom or in the direction of flight as applicable.

FIGURE 7. C. 1 CONTROL ACTUATION FOR FIXED WING AIRCRAFT



|                                     |   |   |
|-------------------------------------|---|---|
| Anti-Torque Pedals                  | Conventional*   |   |
| Anti-Torque Pedal Adjustment        | Control motion to extend pedals is clockwise, push or lift  |   |
| Cyclic Pitch Stick                  | Conventional  | Separate controls for each pilot/ Grip provides: electric trim, force trim, radio, release, rocket firing, gun firing, autopilot  |
| Collective Pitch Stick              | Conventional  | Separate controls for each pilot/ Adjustable friction device for pilot-in-command only  |
| Control System Power Boost          | Performance related   |   |
| Autopilot                           | Performance related   | An emergency cut-off switch is located on the cyclic pitch stick grip   |
| Trim                                | Performance related   | Safeguarded against inadvertent action/ Position and range of adjustment indicated/ Electrical trim is a four-way "Chinese hat"   |
| Force Trim                          | Performance related   |   |
| Landing Gear                        | Performance related   | Proper knob shape/ Indicator light is steady "On" when gear position does not correspond with gear control selection/ Emergency override control has safety device  |
| Alternate Landing Gear Actuation    | A separate and distinct motion from normal operation  |   |
| Wheel Brake                         | Conventional  | With dual brakes, simultaneous braking is possible  |
| Parking Brake                       | Pull to actuate; press pedals to release  |   |
| Wheel Centering Lock                | Upward or forward, or both, to lock; reverse action to unlock   |   |
| Rotor Brake                         | Performance related   | Safety device to prevent rotor from starting with brake on/ Inadvertent operation prevented   |
| Rotor Blade Folding                 | Forward for spread; aft for fold  | Positive interlocks prevent premature or accidental engagement and prevent rotor head rotation during folding   |
| Reciprocating Engines: Rotary Power | Clockwise to increase power (viewed from free end of stick)   | Maximum grip rotation: 150 degrees/ Adjustable friction device operable without moving hand from throttle and on pilot's control only   |
| Turbine Engines: Engine Conditioner | Clockwise actuation (viewed from free end of stick)   | Maximum grip rotation: 150 degrees from "Off"/ Positive stops for each function/ Safety feature to prevent inadvertent rotation to next function/ Friction control operable without removing left hand from stick/ Markings show control function and direction of rotation |
| Engine(s) Speed Trim                | Momentary (beep) switch: forward to increase engine rpm and aft to decrease rpm   | Markings show increase and decrease rpm positions   |
| Beta                                | Clockwise actuation (viewed from free end of stick) for increased pitch; counter clockwise for decreased pitch; positive detent for neutral | 120 degree rotation/ Friction control operable without removing left hand/ Markings show position and direction of rotation   |
| Pitch Trim Speed, Range             | Forward for high range; aft for low range   | Switch position marked  |
| Engine Oil Temperature              | Switch forward of automatic stop detent increases cooling; switch aft, decreases cooling  | Switch position marked  |
| Engine Oil Cooler Flap              | Performance related   | Markings show position  |
| Carburetor Heat, Air Filter         | Performance related   |   |
| Induction System Anti-icing         | Performance related   |   |
| Fuel System Selector                | Mechanical rotary or lever-type control(s) or electrical switch selector(s) are forward or up for "On" and aft or down for "Off"            | Safety device prevents inadvertent cutoff/ If fuel is supplied from several tanks, a diagrammatic fuel system is provided around the selector   |

CONTINUED ON NEXT PAGE

FIGURE 7.C.2 CONTROL ACTUATION FOR ROTARY WING AIRCRAFT

|   |   |                        |
|---|---|------------------------|
| Ignition Switch(es): Reciprocating                                    | Clockwise rotation produces the following sequence: "Ignition", "Start", "Normal" | Ind for are, mnd       |
| Ground Start Switch   | Conventional  | Com fun                |
| Stop Switch   | Conventional  | Cle tior               |
| In-Air Start Switch   | Press for ignition and spring return for "Off"                                    | Pill rem piti Ina on   |
| Firefighting System   | Pull to actuate   | A d or dis ill act shd |
| Master Electrical   | Performance related   |                        |
| Lighting and Miscellaneous  | Performance related   |                        |
| Landing Light and Searchlight   | Performance related   | Act to pit com         |
| Circuit Breakers  | Conventional  | Onk of                 |
| Radio, Radar and Navigation   | Performance related   | Rad swi sta rad be     |
| Weapon(s) Firing Switch   | Squeeze to fire   | Saf art                |
| Armament Sight and Range  | Conventional  |                        |
| External Stores: Release Switch                                       | Press to release  | If or swi rel          |
| Emergency Release Switch  | Pull to release   | In Em has              |
| Oxygen System   | Conventional  |                        |
| External Tow Cable or Cargo Release Switch                            | Push to release   | Swi tes                |
| Cargo Emergency Release   | Push foot pedal or pull hand control  | In Has ped             |
| Moist Control Switch  | Performance related; spring return to "Off" when released                         |                        |
| Defrosting, Deicing, Pilot Heat, Cockpit Air Conditioning, Windshield | Performance related   |                        |
| Ventilating   | Conventional  |                        |
| APU   | Momentary forward to start, center is run, aft is stop                            |                        |
| Shoulder Harness  | Forward to lock   |                        |
| Seat Adjustment   | Movement corresponds to seat motion   |                        |
| Emergency Alarm   | Performance related   | Cur tid                |

MIL-STD-250

\* Conventional indicates all controls are actuated in accordance in the direction of flight as applicable.

FIGURE 7.C.2 (CONTINUED)



| CTION   | COMMENTS   |
|---|--|
| rise rotation produces the<br>ing sequence: "Ignition",<br>", "Normal"          | Individual switches have provision<br>for emergency aborting/ Switches<br>are separated electrically and<br>mechanically   |
| tional  | Combines starter and ignition<br>function  |
| itional   | Clearly marked/ Inadvertent actua-<br>tion prevented   |
| for ignition and spring<br>for "Off"  | Pilot can operate switch without<br>removing his hand from collective<br>pitch stick/ Properly marked/<br>Inadvertent operation has no effect<br>on engine operation                     |
| o actuate   | A single control for each engine<br>at critical area plus one agent<br>discharge switch/ Control knob<br>illuminates when that system is<br>actuated/ Control knob is of proper<br>shape |
| ance related  |  |
| ance related  |  |
| ance related  | Actuation does not require pilot<br>to remove left hand from collective<br>pitch stick/ Searchlight slew<br>control is a four-way "Chinese hat"  |
| tional  | Only those which affect the safety<br>of the flight need be accessible   |
| ance related  | Radio ICS switch is a 3-position<br>switch on cyclic pitch stick/ With<br>stabilization system, other radio,<br>radar, and navigation controls may<br>be on the right side console       |
| to fire   | Safety guard prevents inadvertent<br>actuation   |
| ional   |  |
| o release   | If serving a dual purpose of stores<br>or cargo hook release, a selector<br>switch is provided/ Inadvertent<br>release protected against   |
| release   | In addition to electrical switch/<br>Emergency markings on control<br>handle   |
| ional   |  |
| release   | Selector switch provided/ Inadvert-<br>ent actuation guarded against   |
| or pedal or pull hand   | In addition to electrical switch/<br>Markings show emergency use/ Foot<br>pedal requires positive action   |
| ance related, spring<br>to "Off" when released                                  |  |
| ce related  |  |
| ional   |  |
| try forward to start, center<br>aft is stop                                     |  |
| to lock   |  |
| it corresponds to seat  |  |
| ance related  | Guarded against inadvertent actua-<br>tion   |
| MIL-STD-250   |  |
| ontrols are actuated in accordance with established custom or<br>is applicable. |  |

FIGURE 7.C. 2 (CONTINUED)

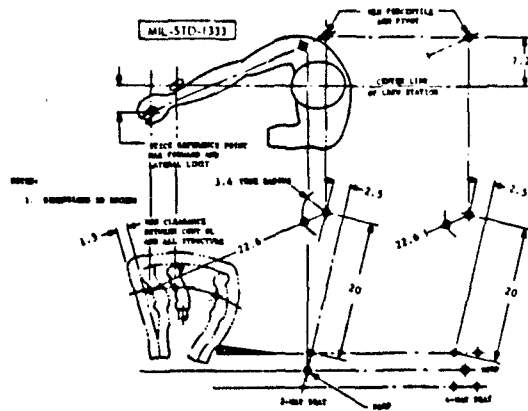


FIGURE 7.D. 1 PITCH AND ROLL CONTROL-STICK TYPE 2-WAY AND 4-WAY SEAT

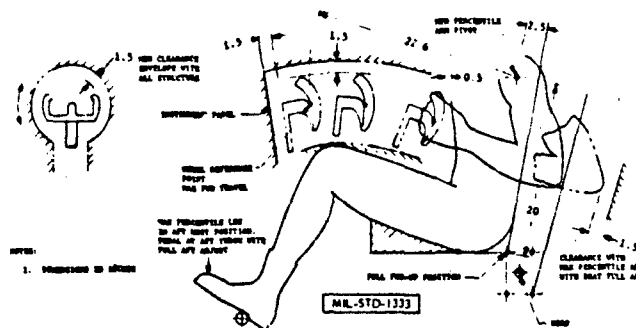


FIGURE 7.D. 2 PITCH AND ROLL CONTROL - WHEEL TYPE

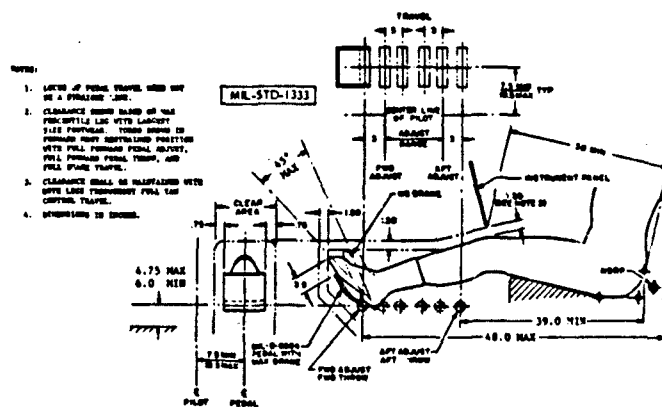


FIGURE 7.D. 3 YAW CONTROL PEDALS



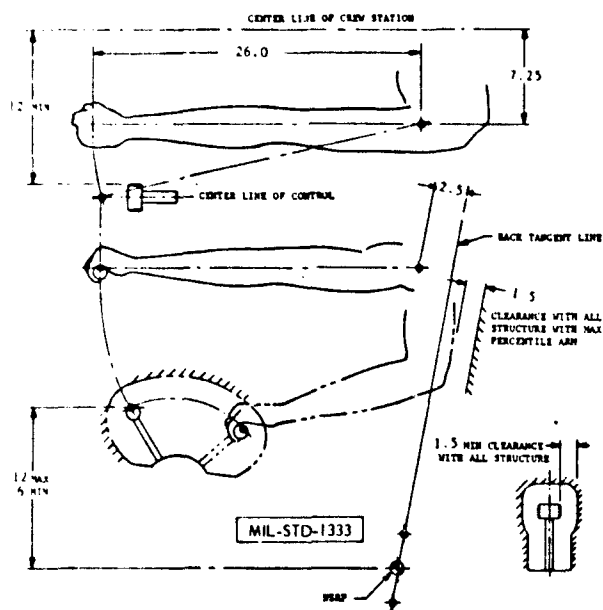


FIGURE 7.D.4 PROPULSION CONTROL GEOMETRY

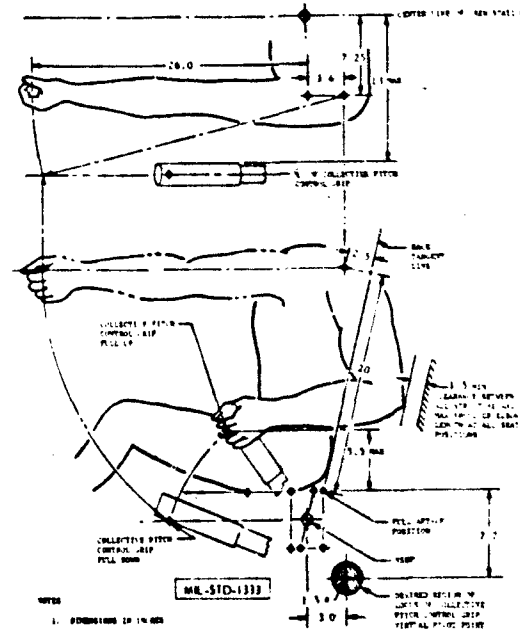
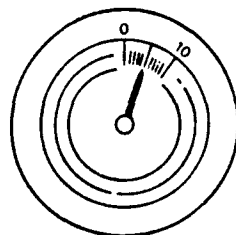
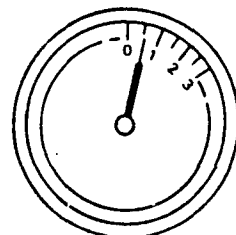


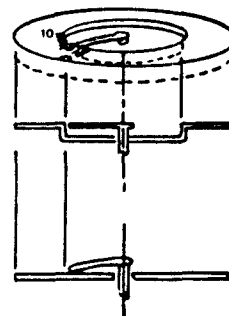
FIGURE 7.D.5 COLLECTION CONTROL GEOMETRY



20% MAXIMUM READING ACCURACY  
THIS P. 1.0 IN. IS AN EQUAL DISTANCE -  
4 MIN. 0.031 (0.061 in (0.8-1.6 mm) -  
FROM ALL SCALE MARKS, NEVER  
OVERLAPPING ANY MARK OR NUMERAL)



ALTERNATE FORMAT FOR GROSS  
READING OF NUMBERS



TO PREVENT OR MINIMIZE  
VISUAL PARALLAX

MIL-STD-1472

RELATIVE POSITION OF SCALE MARKS,  
NUMERALS, AND POINTERS ON CIRCULAR DIALS

FIGURE 8.B.2 CIRCULAR DIALS

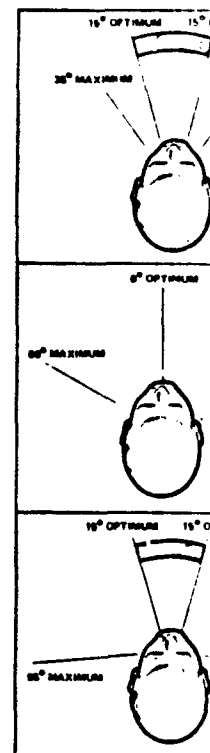


FIGURE 8.E.1 VISUAL FIELD



|              | MECHANICAL COUNTERS   | FLAGS  | PRINTERS   | PLOTTERS   |
|--------------|---|--|--|--|
| APPLICATION  | QUANTITATIVE DATA WHEN CONTINUOUS TREND IS NOT REQUIRED & WHEN QUICK, POSITIVE INDICATION IS REQUIRED   | QUALITATIVE, NON-EMERGENCY CONDITIONS  | VISUAL RECORD OF DATA IS REQUIRED  | VISUAL RECORD OF CONTINUOUS GRAPHIC DATA IS DESIRED  |
| MARKINGS     | HEIGHT TO WIDTH RATIO OF NUMERALS IS 1:1 (EXCEPT NUMBER 11 WHICH IS ONE STROKE WIDTH). HORIZONTAL SEPARATION BETWEEN NUMERALS IS 1/4 - 1/2 NUMERAL WIDTH. CONTRAST BLACK ON WHITE OR WHITE ON BLACK | MINIMUM OF 50% CONTRAST BETWEEN FLAGS & BACKGROUNDS UNLESS ALL EXPECTED AMBIENT LIGHTING CONDITIONS                                | PRESENTED IN DIRECTLY USABLE FORM. PRINT NOT OBLSCURED. MINIMUM OF 50% LUMINANCE CONTRAST BETWEEN PRINTED MATERIAL & BACKGROUND  | PLOTTING POINTS VISIBLE AND NOT OBSTRUCTED BY PEN ASSEMBLY OR ARM. MINIMUM OF 50% LUMINANCE CONTRAST BETWEEN PLOTTED FUNCTION & BACKGROUND                   |
| MOVEMENT     | SNAP ACTION, NOT FASTER THAN 2 SEC/COND IF NUMBERS MUST BE READ CONSECUTIVELY   | SNAP ACTION  | AS REQUIRED  | AS REQUIRED  |
| ILLUMINATION | SELF-ILLUMINATED WHEN AMBIENT PROVIDES BELOW 3.5 cd/m <sup>2</sup> DISPLAY LUMINANCE  | AMBIENT  | SELF-ILLUMINATION IF REQUIRED  | SELF-ILLUMINATION IF REQUIRED  |
| OTHER        | MOUNTED CLOSE TO PANEL SURFACE TO MINIMIZE VIEWING ANGLE & MINIMIZE SHADOWS. MATTE COATING DRUM AND SURROUND TO MINIMIZE SHADOWS & MAXIMIZE VIEWING ANGLE   | MOUNTED CLOSE TO PANEL SURFACE. MALFUNCTION INDICATION PARTIALLY OBSCURES VIEW OF MALFUNCTIONING DISPLAY. TEST PROVISION AVAILABLE | QUICK & EASY INSERTION & REMOVAL OF PRINTING MATERIALS. TAKE-UP DEVICE PROVIDED. ANNOTATION PROVISION AVAILABLE WHERE APPLICABLE | TAKEUP DEVICE PROVIDED WHERE APPLICABLE. ANNOTATION PROVISION FURNISHED WHERE APPLICABLE. JOB AIDS PROVIDED WHERE NEEDED, BUT DO NOT OBSCURE OR DISTORT DATA |

MIL-STD-1472

FIGURE 8.B.1 COUNTERS, FLAGS, PRINTERS, AND PLOTTERS

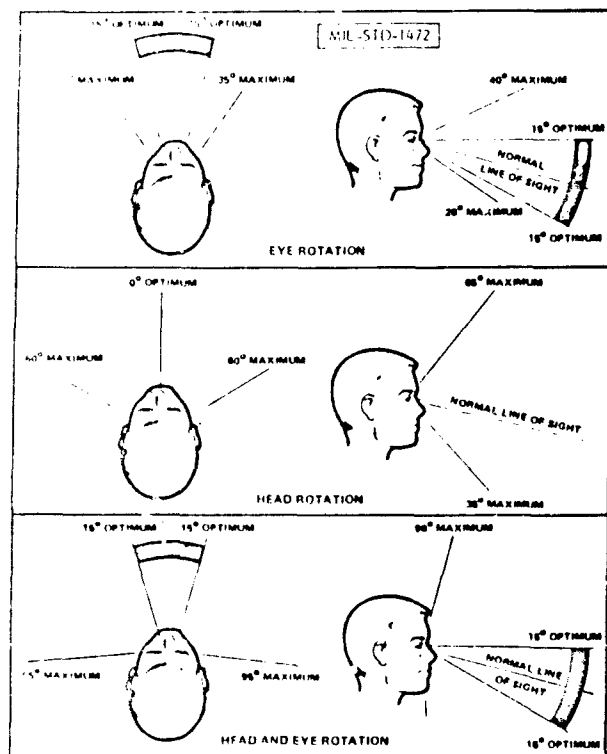


FIGURE 8.E.1 VERTICAL AND HORIZONTAL VISUAL FIELD

| FACTOR  | OPTIMUM                          | PREFERRED LIMITS                      | ACCEPTABLE LIMITS                     |
|---|----------------------------------|---------------------------------------|---------------------------------------|
| RATIO OF VIEWING DISTANCE<br>SCREEN DIAGONAL  | 4                                | 3-6                                   | 2-8                                   |
| * IMAGE LUMINANCE (NO FILM IN<br>OPERATING PROJECTOR)   | 10 fL<br>(35 cd/m <sup>2</sup> ) | 5-14 fL<br>(27-65 cd/m <sup>2</sup> ) | 5-30 fL<br>(27-79 cd/m <sup>2</sup> ) |
| LUMINANCE VARIATION ACROSS SCREEN<br>(RATIO OF MAXIMUM TO MINIMUM<br>LUMINANCE)                     | 1                                | 1.5                                   | 2.0                                   |
| LUMINANCE VARIATION AS A FUNCTION<br>OF VIEWING LOCATION (RATIO OF<br>MAXIMUM TO MINIMUM LUMINANCE) | 1                                | 2.0                                   | 4.0                                   |
| RATIO OF AMBIENT LIGHT<br>BRIGHTEST PART OF IMAGE   | 0                                | 0.005-0.01                            | 0.1 max **                            |

\* FOR STILL PROJECTIONS HIGHER VALUES MAY BE USED  
\*\* FOR PRESENTATIONS NOT INVOLVING GRAY SCALE OR COLOR (e.g., LINE DRAWINGS, TABLES)  
0.2 MAY BE USED.

MIL-STD-1472

FIGURE 8.E.2 GROUP VIEWING OF OPTICAL PROJECTION DISPLAYS



|   |   |   |                             |
|---|---|---|-----------------------------|
| Indicator reading, dark adaptation necessary                    | Red, Red, indirect, or both, with operator choice                                 | 0.02-0.1<br>(0.07-0.34)                               | Continuous throughout range |
| Indicator reading, dark adaptation not necessary, but desirable | Red or low color-temperature white flood, indirect, or both, with operator choice | 0.02-1.0<br>(0.07-3.43)                               | Continuous throughout range |
| Indicator reading, dark adaptation not necessary                | White flood   | 10-20.0<br>(3.4-68.5)                                 | Flood or continuous         |
| Panel monitoring, dark adaptation necessary                     | Red edge lighting, red or white flood, or both, with operator choice              | 0.02-1.0<br>(0.07-3.43)                               | Continuous throughout range |
| Panel monitoring, dark adaptation not necessary                 | White flood   | 10.0-20.0<br>(3.4-68.5)                               | Flood or continuous         |
| Possible exposure to bright flashes, restricted daylight        | White flood   | 10.0-20.0<br>(3.4-68.5)                               | Flood                       |
| Chart reading, dark adaptation necessary                        | Red or white flood with operator choice   | 0.1-1.0<br>(0.34-3.43)<br>(on white portion of chart) | Continuous throughout range |
| Chart reading, dark adaptation not necessary                    | White flood   | 5.0-20.0<br>(17.1-68.5)                               | Flood or continuous         |

MIL-STD-1472

FIGURE 8.E.3 RECOMMENDATIONS FOR DISPLAY LIGHTING

FIGURE 8.E.4 LEGIBILITY OF DATA ON LARGE SCREEN OPTICAL PROJECTION DISPLAYS

| CHARACTERISTIC          | CONDITION  | LIMITS   |
|-------------------------|--|--|
| LETTER/NUMERAL STYLE    | GENERAL APPLICATIONS<br>EXTENDED COPY  | CAPITALS<br>STANDARD   |
| STROKE WIDTH/HEIGHT     | DARK MARKINGS<br>LIGHT MARKINGS  | 1/8 - 1/8<br>1/16  |
| LETTER & NUMERAL HEIGHT | REQUIRED FROM LOWEST ANTICIPATED VIEWING DISTANCE<br>DESIRED FROM LOWEST ANTICIPATED VIEWING DISTANCE    | 3.0 BRAD VIS ANGLE (MINIMUM)<br>4.8 BRAD VIS ANGLE (MINIMUM)           |
| LUMINANCE RATIO         | OPTIMAL LIGHTING<br>CHARTS, PRINTING, LINEWORK<br>LIMITED SHADOWS & DETAIL<br>FULL RANGE COLORS OR GRAYS | 80:1 (PREFERRED)<br>5:1 (MINIMUM)<br>25:1 (MINIMUM)<br>100:1 (MINIMUM) |

MIL-STD-1472

|   |   |
|---|---|
| 1/2 INCH (12mm) DIAMETER or SMALLER/STEADY                  | Malfunction, action stopped, failure, stop action               |
| 1 INCH (25mm) DIAMETER or LARGER/STEADY                     | Master summation (system or subsystem)                          |
| 1 1/2 INCH (38mm) DIAMETER or LARGER/FLASHING (3 Hz 5/sec.) | Emergency condition (impending personnel or equipment disaster) |

FIGURE 8.F.1 CODE

| FUNCTION                | TYPE OF SIGNAL  |   |   |
|-------------------------|---|---|---|
|                         | TONES (Periodic)  | COMPLEX SOUNDS (Non-Periodic)   | SPEECH  |
| QUANTITATIVE INDICATION | <b>POOR</b><br>Mixtures of 6 to 8 tones absolutely recognizable.  | <b>POOR</b><br>Interpretation between signals uncertain.                                    | <b>GOOD</b><br>Minimum delay and error in obtaining exact value in terms of acceptable code response.   |
| QUALITATIVE INDICATION  | <b>POOR TO FAIR</b><br>Difficult to judge approximate value and direction of deviation from null setting unless presented in close temporal sequence. | <b>POOR</b><br>Difficult to judge approximate value deviation from desired value.           | <b>GOOD</b><br>Information concerning displacement, direction, and rate presented in form compatible with required response.  |
| STATUS INDICATION       | <b>GOOD</b><br>Short and long tones. Continuous information where rate of change of input is low.   | <b>GOOD</b><br>Separately suitable for irregularly occurring signals (e.g., alarm signals). | <b>POOR</b><br>Inefficient, more easily misread, provides of readability.   |
| TRACKING                | <b>FAIR</b><br>Not positive multi-measured, problems of signal-response compatibility.  | <b>POOR</b><br>Required continuous continuous difficult to provide.                         | <b>GOOD</b><br>Missing element in signal.   |
| GENERAL                 | Good for automatic non-interpretation of limited information. Meaning must be learned. Easily generated.  | Some sounds available with common meaning (e.g., fire bell). Easily generated.              | Most effective for rapid but not unimportant communication of complex, multi-dimensional information. Meaning learned in signal and control system environment. Minimum of new learning required. |

MIL-STD-1472

FIGURE 8.F.3 FUNCTIONAL EVALUATION OF AUDIO SIGNALS

| DISPLAY               | CONDITION  |
|-----------------------|--|
| LIGHT EMITTING DIODES | COLOR CODING<br>LAMP TEST  |
| DOT MATRIX/SEGMENTED  | SYMBOL DEFINITION<br><br>SYMBOL HEIGHT<br><br>SYMBOL HEIGHT FOR FLIGHT DISPLAYS<br><br>LETTER STYLE<br><br>VIEWING ANGLE<br><br>COLOR OF MONOCHROMATIC EMITTERS (IN ORDER OF PREFERENCE) |
| ELECTROLUMINESCENT    | SYMBOL HEIGHT<br><br>SYMBOL HEIGHT FOR FLIGHT DISPLAYS   |

FIGURE 8.F.4 OTHER DISPLAYS



| DIAMETER or SMALLER STEADY                             | shaped failure stop action                                    | redback                            | reference, acceptable ready            | physical position, action in progress |
|--|---|------------------------------------|--|---------------------------------------|
| 1 INCH (25mm) DIAMETER or LARGER STEADY                | Master summation (system or subsystem)                        | Extreme caution (impending danger) | Master summation (system or subsystem) |                                       |
| 1 INCH (25mm) DIAMETER or LARGER FLASHING (3 to 5 sec) | Emergency caution (impending personnel or equipment disaster) |                                    |  |                                       |

MIL-STD-1472

FIGURE 8.F.1 CODING OF SIMPLE INDICATOR LIGHTS

| QUANTITATIVE INFORMATION | May be difficult to read while pointer is in motion  | May be difficult to read while scale is in motion   | Minimum time and error for exact indicated value  | Minimum time and error for exact indicated value. Parameter reference results | N/A  |
|--------------------------|--|---|---|---|--|
| QUALITATIVE INFORMATION  | GOOD<br>Location of pointer easy. Numerical and scale need not be read. Pointer change easily detected.            | POOR<br>Difficult to judge direction and magnitude of displacement without reading numbers and scale.   | POOR<br>Numbers not to be read. Pointer change not easily detected.   | POOR<br>Numbers must be read. Pointer change not easily detected.             | GOOD<br>Easily detected & measured of value. |
| SETTING                  | GOOD<br>Simple and direct relation of motion of pointer to motion of setting knob. Pointer change into monitoring. | FAIR<br>Relation to motion of setting knob may be ambiguous. No pointer position change to aid monitoring. Not readable during rapid setting. | GOOD<br>Most accurate monitoring of numerical setting. Relation to motion of setting knob less direct than for moving pointer. Not read while during rapid setting. | N/A   | N/A  |
| TRACKING                 | GOOD<br>Pointer position readily controlled and monitored. Brightest relation to numerical setting motion.         | FAIR<br>No pointer change to aid monitoring. No relation to numerical motion convenient indication.   | POOR<br>No gross relation change to aid monitoring.   | N/A   | N/A  |
| GENERAL                  | Requires largest segment and is illuminated only on panel. Scale length limited unless multiple pointers used.     | Some panel space. Only small motion of scale need be indicated and is illuminated. Use of tape where heavy scale.                             | Most convenient of scale and if indicator. Scale length limited only by number of indicator dials.  | Limited application.  | Limited application.                         |

MIL-STD-1472

FIGURE 8.F.2 APPLICATION OF VARIOUS TYPES OF MECHANICAL DISPLAYS

| CONDITION  | LIMIT  |
|--|--|
| COLOR CODING   | SAME AS FIGURE 8.F.1   |
| LAMP TEST  | NOT REQUIRED IF 100 K HRS. MTBF MINIMUM                              |
| SYMBOL DEFINITION  | 5 BY 7 (MINIMUM)<br>7 BY 9 (PREFERRED)                               |
| SYMBOL HEIGHT  | 4.7 MRAD VISUAL ANGLE (MINIMUM)                                      |
| SYMBOL HEIGHT FOR FLIGHT DISPLAYS                        | 7.0 MRAD VISUAL ANGLE (MINIMUM)                                      |
| LETTER STYLE   | UPPER CASE   |
| VIEWING ANGLE  | 610 MRAD OFF AXIS (MAXIMUM)  |
| COLOR OF MONOCHROMATIC EMITTERS (IN ORDER OF PREFERENCE) | GREEN (555 NM)<br>YELLOW (575 NM)<br>ORANGE (585 NM)<br>RED (660 NM) |
| SYMBOL HEIGHT  | 4.5 MRAD VISUAL ANGLE (MINIMUM)                                      |
| SYMBOL HEIGHT FOR FLIGHT DISPLAYS                        | 7.0 MRAD VISUAL ANGLE (MAXIMUM)                                      |

MIL-STD-1472

FIGURE 8.F.4 OTHER DISPLAYS

|                               |  |
|-------------------------------|--|
| LOCATION (CRITICAL FUNCTIONS) | WITHIN 15 DEG OF NORMAL LINE OF SIGHT (FIGURE 8.E.1) |
| LUMINANCE MINIMUM             | 10% GREATER THAN SURROUND                            |
| LUMINANCE MAXIMUM             | 300% GREATER THAN SURROUND                           |
| WITHIN - INDICATOR CONTRAST   | 50% MINIMUM FIGURE-GROUND RELATIONSHIP               |
| COLORS GENERAL                | TYPE I - AVIATION COLORS, MIL-C-25050                |
| TRAINING EQUIPMENT            | MIL-T-23991  |
| AIRCREW STATION SIGNALS       | MIL-STD-411  |
| COLOR CODING                  | SEE FIGURE 8.F.1                                     |

MIL-STD-1472

FIGURE 8.F.5 TRANSILLUMINATED DISPLAYS



Prohibited Types of Signals - The following types of signals should not be used as warning devices where possible confusion might result because of the operational environment:

- Modulated or interrupted tones that resemble navigation signals or coded radio transmissions.
- Steady signals that resemble hisses, static, or sporadic radio signals.
- Trains of impulses that resemble electrical interference whether regularly or irregularly spaced in time.
- Simple warbles which may be confused with the type made by two carriers when one is being shifted in frequency (beat-frequency-oscillator effect).
- Scrambled speech effects that may be confused with cross modulation signals from adjacent channels.
- Signals that resemble random noise, periodic pulses, steady or frequency modulated simple tones, or any other signals generated by standard countermeasure devices (e.g., "bagpipes").
- Signals similar to random noise generated by air conditioning or any other equipment.
- Signals that resemble sounds likely to occur accidentally under operational conditions.

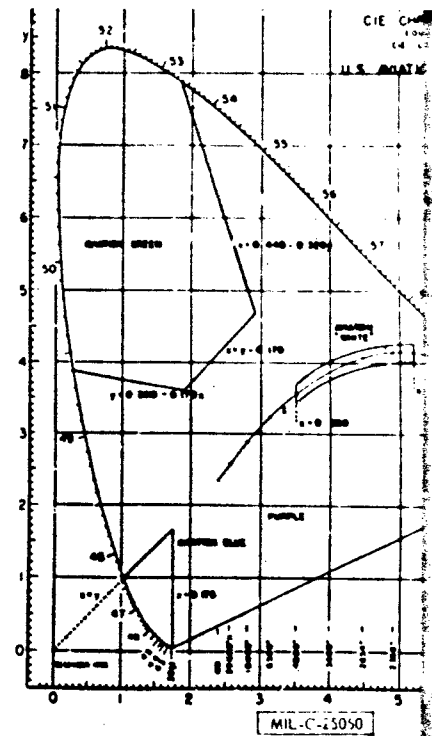
MIL-STD-1472

FIGURE 8.G.1 PROHIBITED TYPES OF SIGNALS

| NOMENCLATURE                       | LEGEND      |
|------------------------------------|-------------|
| Bail Out                           | Bail Out    |
| Cabin Pressurization Failure       | Cabin Press |
| Control Launch Bar Malfunction     | Launch Bar  |
| Emergency Fuel Failure             | Fuel Fail   |
| Emergency Fuel Regulator           | Fuel Reg    |
| Engine Overheated                  | Eng Hot     |
| Fire Engine Compartment            | Fire Eng    |
| Fire Nose Section                  | Fire Nose   |
| Fire Engine                        | Fire Eng    |
| Fuel System Left Failure           | L Fuel      |
| Fuel System Right Failure          | R Fuel      |
| Instrument Power Off or Failure    | Inst Pwr    |
| Instrument Inverter Off or Failure | Inst Inv    |
| Landing Gear                       | Gear        |
| Low Altitude Warning               | Alt Low     |
| Master Warning Light               | Master Warn |
| Nose Warning                       | Nose Warn   |
| Tail Warning                       | Tail Warn   |
| Wheels                             | Wheels      |

MIL-STD-411

FIGURE 9.H.1 LEGEND FOR WARNING SIGNALS

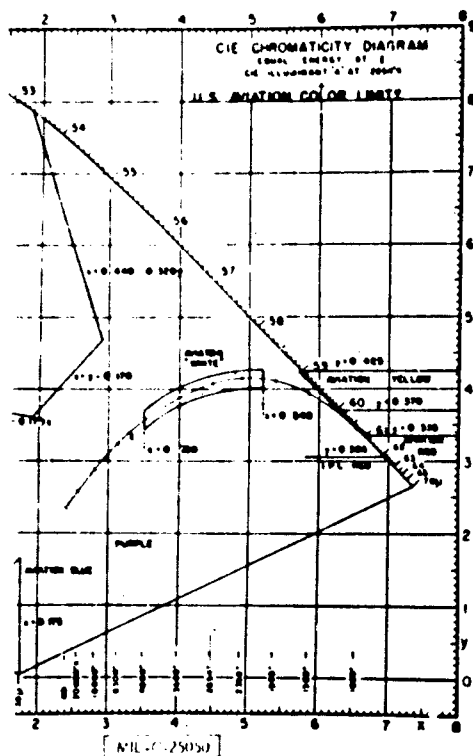


(Training equipment colors can be as)

FIGURE 9.E.1 C.I.E. MIXTURE DIAGRAM SHOWING

| NOMENCLATURE                            |
|---|
| Aileron Trim Failure                    |
| Automatic Power Control Off             |
| Auxiliary Alternating Current Power     |
| Anti-Skid Off                           |
| Automatic Feather Out                   |
| Automatic Pilot Failure                 |
| Auxiliary Power Unit Off                |
| Boost Off                               |
| Constant Speed Drive Failure            |
| Defroster Failure                       |
| Direct Current Generator Off or Failure |
| Door Open                               |
| Engine Icing                            |
| Engine Negative Thrust Control Failure  |
| Fuel Icing                              |
| Fuel Low                                |
| Generator # - Inoperative or Out        |
| Guide Vane Icing                        |
| Heat and Vent Overheated                |
| Helium Warning                          |
| Hydraulic Pressure Low                  |
| Hydraulic Pump Failure                  |
| Left Alternate Current Bus Off          |
| Left Auxiliary Fuel Tank Low            |





(Note: Equipment colors can be approximate)

FIGURE 9. F. 1 MIXTURE DIAGRAM SHOWING AVIATION COLOR LIMITS

**MASTER**

A non-verbal audio master warning signal shall produce an output with the following frequency and interruption rates:

- (a) Fundamental audio output frequency shall sweep from 700 Hz to 1,700 Hz in 0.85 second.
- (b) Interruption interval 0.12 second.
- (c) The cycle shall be repeated until the signal generator is deenergized.

**BAIL OUT**

The audio bail-out signal for use in troop carriers, cargo transport, and all other multi-crew aircraft shall be a bell. The bell shall strike at a continuous rate of 5 to 6 beats per second and shall be audible during flight to all aircrew members and passengers.

**WHEELS-UP**

When a non-verbal audio wheels-up signal is used, it shall have the following tone:

Frequency 250 ± 50 Hz, fundamental tone interrupted at 5.0 ± 0.5 Hz with a 50 ± 10 percent on-off cycle.

| ANGLE OF ATTACK / AIR SPEED / STALL |           |  |
|-------------------------------------|-----------|--|
| ANGLE OF ATTACK                     | AIR SPEED | TONE SIGNAL MIL-STD-411  |
| Low                                 | Fast      | 1,600 tone interrupted at a rate of 1 to 10 Hz, the rate increasing linearly with decreasing angle of attack/increasing air speed.                               |
| Safe Low                            | Safe fast | 900 Hz steady tone, plus 1,600 Hz tone interrupted at a rate of zero to 1 Hz, the rate increasing linearly with decreasing angle of attack/increasing air speed. |
| Correct                             | Correct   | 900 Hz steady tone.  |
| Safe high                           | Safe low  | 900 Hz steady tone, plus 400 Hz tone interrupted at a rate of zero to 1 Hz, the rate increasing linearly with increasing angle of attack/decreasing air speed.   |
| High                                | Slow      | 400 Hz tone interrupted at a rate of 1 Hz to 10 Hz, the rate increasing linearly with increasing angle of attack/decreasing air speed (stall warning).           |

FIGURE 9. F. 1 NON-VERBAL WARNING SIGNALS

| NOMENCLATURE              | LEGEND          | NOMENCLATURE                    | LEGEND         |
|---------------------------|-----------------|---------------------------------|----------------|
| Failure                   | All Trim        | Left Rectifier Failure          | L Rect         |
| Air Control Off           | APC Off         | Mach Warning                    | Mach Warn      |
| Alternating Current Power | Aux AC Pwr      | Master Caution                  | Master Caution |
|                           | Anti-Skid       | Nozzle Failure                  | Nozzle         |
| Door Out                  | Auto Feeth      | Oil Overheated                  | Oil Hot        |
| Engine Failure            | Auto-Pilot      | Oil Pressure Low                | Oil Press      |
| Engine Unit Off           | Aux Pwr Unit    | Oxygen Quantity Low             | Oxy Low        |
|                           | Boost Off       | Oxygen Regulator Failure        | Oxy Reg        |
| Drive Failure             | Cat Spd Dr      | Pitch Damper Failure            | Pitch Dmp      |
| Engine                    | Defrost         | Power Inverter Off or Failure   | Pwr Inv        |
| Generator Off or Failure  | DC Gen          | Radar Inoperative               | Radar Out      |
|                           | Door Open       | Range Limit - Left Tank         | L Tank Lmt     |
|                           | Eng Ice         | Range Limit - Right Tank        | R Tank Lmt     |
| Thrust Control Failure    | Neg Thrust      | Rectifier # - Out               | # - Rect       |
|                           | Fuel Ice        | Right Alternate Current Bus Off | R AC Bus       |
|                           | Fuel Low        | Right Auxiliary Fuel Tank Low   | R Aux Fuel Low |
| Operative or Out          | # - Gen         | Right Rectifier Failure         | R Rect         |
| Wing                      | Vane Ice        | Rotor Brake On                  | Rotor Brake On |
| Overheated                | Heat & Vent Hot | Surface Overheated              | Surface Hot    |
| Helium                    | Helium          | Transmission Oil Hot            | Trans Oil Hot  |
| Hyd Press                 | Hyd Press       | Winch Drive Failure             | Winch Dr       |
| Hyd Pump                  | Hyd Pump        | # - Alternator Out              | # - Alter      |
| L AC Bus                  | L AC Bus        | # - Propeller Reversed          | # - Prop Revr  |
| Fuel Tank Low             | L Aux Fuel Low  |                                 |                |

MIL-STD-411

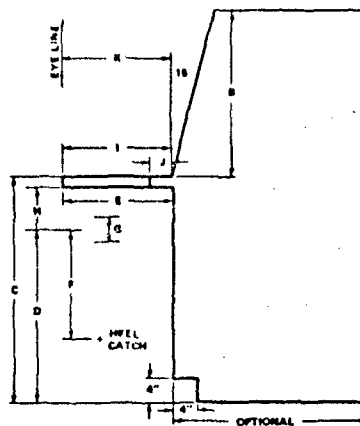
FIGURE 9. H. 2 LEGEND FOR CAUTION SIGNALS



| SYMBOL/NOTATION      | LEGEND              |
|----------------------|---------------------|
| AC                   | Alternating Current |
| DC                   | Direct Current      |
| Ext Power            | External Power      |
| Marker Beacon        | Marker Beacon       |
| Radar                | Radar               |
| Trimmed for Take Off | T/O Trim            |

MIL-STD-411

FIGURE 9.H.3 LEGEND FOR ADVISORY SIGNALS



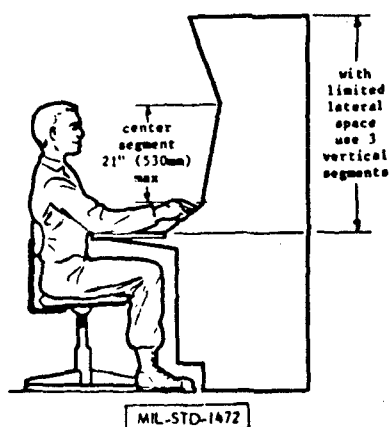
| TYPE OF CONSOLE                  | TOTAL CONSOLE<br>HEIGHT (INCHES) | VERT<br>(INCHES) |
|----------------------------------|----------------------------------|------------------|
| 1. SIT (W/ VISION OVER<br>TOP)   | 47.5 in (1210 mm)                | 2                |
| 2. SIT (W/ VISION OVER<br>TOP)   | 54.0 in (1370 mm)                | 2                |
| 3. SIT (W/ VISION OVER<br>TOP)   | 61.5 in (1560 mm)                | 2                |
| 4. STAND (W/ VISION OVER<br>TOP) | 62.0 in (1570 mm)                | 2                |
| 5. STAND (W/ VISION OVER<br>TOP) | 72.0 in (1830 mm)                | 2                |

\*THE RANGE IN "A" IS PROVIDED TO ALLOW LATITUDE  
RELATIONSHIP TO "C" AND "D".

| KEY | DIMENSIONS   | IN        | MM        |
|-----|--|-----------|-----------|
| A   | MAXIMUM TOTAL CONSOLE HEIGHT FROM STANDING SURFACE   | SEE TABLE | SEE TABLE |
| B   | SUGGESTED VERTICAL DIMENSION OF PANEL IN J. SILL     | 16        | (400)     |
| C   | WRITING SURFACE SHELF HEIGHT FROM STANDING SURFACE   | 18        | (450)     |
| D   | SEAT HEIGHT FROM STANDING SURFACE AT MIDPOINT OF "G" | 6         | (150)     |
| E   | MINIMUM KNEE CLEARANCE                               | 7.5       | (190)     |
| F   | FOOT SUPPORT TO SITTING SURFACE**                    | 16        | (400)     |
| G   | SEAT ADJUSTABILITY                                   | 4         | (100)     |
| H   | MINIMUM THIGH CLEARANCE AT MIDPOINT OF "G"           | 16        | (400)     |
| I   | WRITING SURFACE DEPTH INCLUDING SHELF                | 4         | (100)     |
| J   | MINIMUM SHELF DEPTH                                  | 16        | (400)     |
| K   | EYE LINE TO CONSOLE FRONT DISTANCE                   | 16        | (400)     |

NOTE: A SHELF THICKNESS OF 1 in. (25 mm) IS ASSUMED. FOR OTHER SHELF THICKNESSES,  
SUITABLE ADJUSTMENTS SHOULD BE MADE.

NOT APPLICABLE  
TO CHAIRS

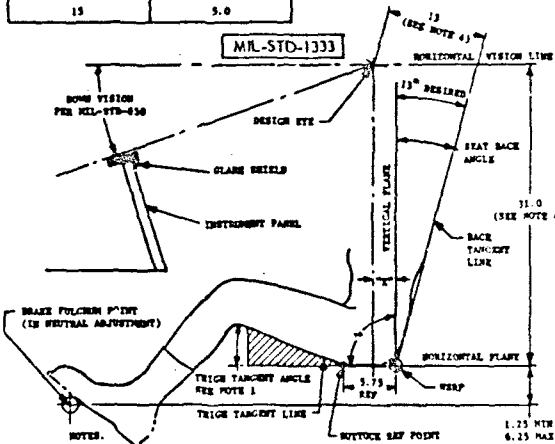
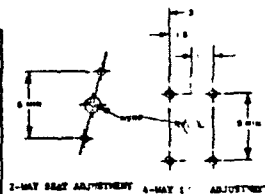


MIL-STD-1472

FIGURE 10.B.3 EXAMPLE OF  
VERTICAL/STACKED SEGMENTS

DISTANCE FROM DESIGN EYE POSITION TO VERTICAL PLANE OF  
CENTRAL SEAT REFERENCE POINT FOR VARIOUS SEAT  
BACK ANGLES

| SEAT BACK ANGLE<br>(DEGREES) | "X" (INCHES) |
|------------------------------|--------------|
| 10                           | 7.7          |
| 11                           | 7.4          |
| 12                           | 7.1          |
| 13                           | 6.8          |
| 14                           | 6.5          |
| 15                           | 6.2          |
| 16                           | 5.9          |
| 17                           | 5.6          |
| 18                           | 5.3          |
| 19                           | 5.0          |
| 20                           | 4.7          |



1. TRIG TANGENT ANGLE SHALL BE A MINIMUM OF 3° AND A MAXIMUM OF 10°. FOR HELICOPTERS, THE MINIMUM OF 10° SHALL APPLY.
2. THE SEAT ADJUSTMENTS SHOWN ARE FOR THE 5TH THROUGH 95TH PERCENTILE PILOT POPULATION.
3. THE VERTICAL DIMENSION RANGE FROM VERT TO SEAT REFERENCE POINT DOES NOT INCLUDE VERTICAL SEAT ADJUSTMENT DIMENSIONS.
4. DIMENSIONS BASED ON 11° SEAT BACK ANGLE.

FIGURE 10.B.4 AIRCREW SEATING GEOMETRY

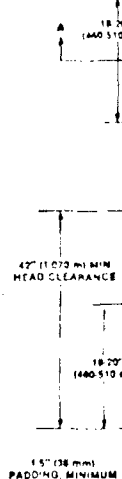
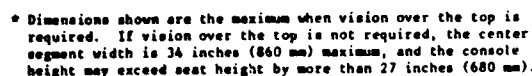


FIGURE 10.B.5



IS PROVIDED TO ALLOW LATITUDE IN THE VOLUME OF THE LOWER PART OF THE CONSOLE; NOTE "C" AND "D".



**FIGURE 10. B. 2 EXAMPLE OF HORIZONTAL WRAP-AROUND CONSOLE**

| 2          | 1979      |
|------------|-----------|
| Life Table | SEE TABLE |
| 18         | (480)     |
| 18         | (460)     |
| 6          | (150)     |
| 7.5        | (180)     |
| 16         | (400)     |
| 4          | (100)     |
| 16         | (400)     |

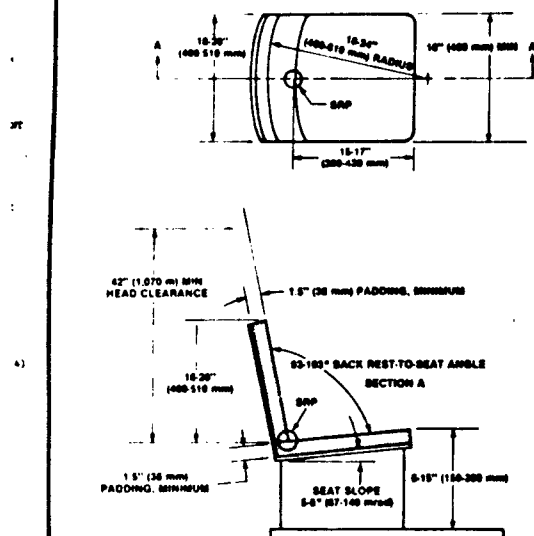
## ICKNESSES

MIL-STD-1472

**FIGURE 10.B.1 STANDARD CONSOLE DIMENSIONS**

\*NOT APPLICABLE TO CONSOLE TYPES 4 AND 5 OF TABLE.

\*\*SINCE THIS DIMENSION MUST NOT BE EXCEEDED, A HEEL CATCH MUST BE ADDED TO THE CHAIR IF "D" EXCEEDS 18 in. (460 mm).



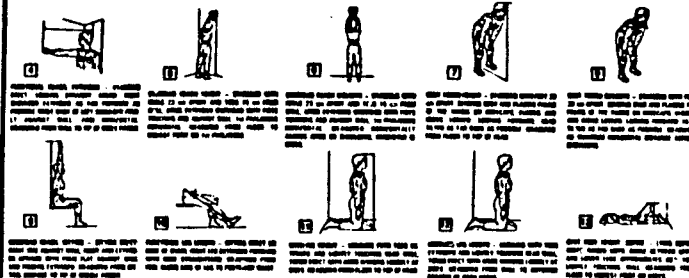
MIL-STD-1472

**FIGURE 10. B. 6 DIMENSIONS FOR  
VEHICLE OPERATOR'S SEAT**

| PERCENTILE VALUES IN CENTIMETERS |       |                 |       |
|----------------------------------|-------|-----------------|-------|
| 50th PERCENTILE                  |       | 85th PERCENTILE |       |
| MALE                             | WOMAN | MALE            | WOMAN |
| 50.0                             | 46.0  | 60.2            | 74.0  |
| 50.5                             | 46.5  | 60.6            | 75.0  |
| 72.0                             | 64.0  | 80.4            | 79.0  |
| 86.1                             | 75.5  | 90.7            | 82.0  |
| 99.0                             | 88.5  | 98.3            | 97.1  |
| 99.5                             | 79.5  | 91.0            | 97.0  |
| 110.0                            | 90.0  | 100.0           | 100.0 |
| 110.5                            | 90.5  | 100.0           | 100.0 |
| 127.0                            | 117.4 | 110.0           | 120.0 |
| 170.0                            | 177.7 | 140.0           | 150.0 |
| 191.0                            | 114.0 | 150.0           | 130.0 |
| 215.0                            | 90.0  | 70.0            | 70.0  |
| 247.0                            | 61.0  | 60.0            | 40.0  |
| 250.0                            | 140.0 | 17.0            | 10.0  |

| PERCENTILE VALUES IN INCHES |       |                 |       |
|-----------------------------|-------|-----------------|-------|
| 50th PERCENTILE             |       | 85th PERCENTILE |       |
| MALE                        | WOMAN | MALE            | WOMAN |
| 19.6                        | 18.1  | 23.8            | 29.1  |
| 20.1                        | 18.6  | 24.2            | 30.1  |
| 28.0                        | 25.0  | 31.8            | 31.1  |
| 33.2                        | 30.0  | 35.9            | 32.0  |
| 39.0                        | 36.0  | 40.0            | 36.7  |
| 42.0                        | 42.0  | 46.0            | 46.0  |
| 46.1                        | 48.0  | 50.0            | 50.0  |
| 46.5                        | 48.5  | 57.0            | 50.0  |
| 60.0                        | 59.0  | 66.0            | 51.0  |
| 68.0                        | 61.0  | 68.0            | 61.0  |
| 70.0                        | 60.0  | 60.0            | 51.0  |
| 80.0                        | 66.0  | 65.1            | 64.0  |



MIL-STD-1472

**FIGURE 10.D.1 ANTHROPOMETRIC DATA FOR COMMON WORK POSITIONS**



|                            | DIMENSIONS (mm) |           |                |
|----------------------------|-----------------|-----------|----------------|
|                            | MINIMUM         | PREFERRED | ARCTIC CLOTHED |
| A. TWO MEN PASSING ABREAST | 1,800           | 1,370     | 1,530          |
| B. TWO MEN PASSING FACING  | 700             | 610       | 610            |
| CATWALK DIMENSIONS         |                 |           |                |
| C. HEIGHT                  | 1,800           | 1,800     | 1,810          |
| D. SHOULDER WIDTH          | 600             | 610       | 610            |
| E. WALKING WIDTH           | 300             | 300       | 300            |
| F. VERTICAL ENTRY MATCH    | 600             | 600       | 610            |
| G. HORIZONTAL ENTRY MATCH  | 600             | 610       | 610            |
| H. CRAWL THROUGH PIPE      | 630             | 700       | 610            |
| SUPINE WORK SPACE          |                 |           |                |
| I. HEIGHT                  | 610             | 610       | 600            |
| J. LENGTH                  | 1,800           | 1,810     | 1,900          |
| SQUATTING WORK SPACE       |                 |           |                |
| K. HEIGHT                  | 1,200           | —         | 1,200          |
| L. WIDTH                   | 600             | 610       | —              |
| M. OPTIMUM DISPLAY AREA    | 600             | 1,000     | —              |
| N. OPTIMUM CONTROL AREA    | 600             | 600       | —              |
| STOOPING WORK SPACE        |                 |           |                |
| O. WIDTH                   | 600             | 1,000     | 1,120          |
| P. OPTIMUM DISPLAY AREA    | 610             | 1,200     | —              |
| Q. OPTIMUM CONTROL AREA    | 610             | 600       | —              |
| KNEELING WORK SPACE        |                 |           |                |
| R. WIDTH                   | 1,000           | 1,200     | 1,270          |
| S. HEIGHT                  | 1,400           | —         | 1,600          |
| T. OPTIMUM WORK POINT      | —               | 600       | —              |
| U. OPTIMUM DISPLAY AREA    | 610             | 600       | —              |
| V. OPTIMUM CONTROL AREA    | 610             | 600       | —              |
| KNEELING CRAWL SPACE       |                 |           |                |
| W. HEIGHT                  | 700             | 610       | 600            |
| X. LENGTH                  | 1,500           | —         | 1,700          |
| PRONE WORK OR CRAWL SPACE  |                 |           |                |
| Y. HEIGHT                  | 430             | 610       | 610            |
| Z. LENGTH                  | 2,000           | —         | —              |

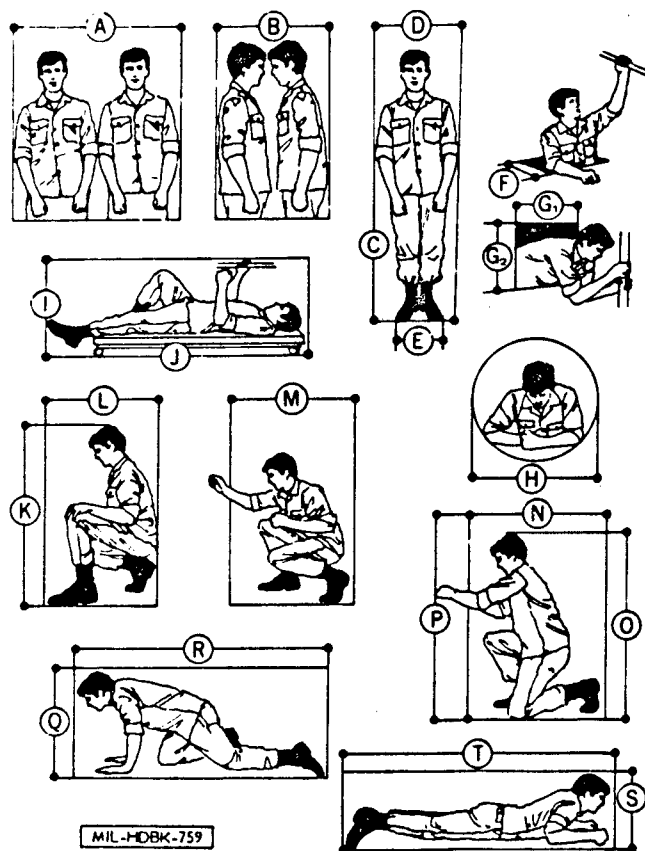


FIGURE 10.D.2. MOBILE WORKSPACE DIMENSIONS

MIL-STD-1472

|   | Light Clothing<br>In. (cm) | Bulky Clothing<br>In. (cm) |
|---|----------------------------|----------------------------|
| Minimum height allowance for standing               | 76 (193)                   | 78 (198)                   |
| Minimum height allowance for crawling               | 31 (79)                    | 34 (86)                    |
| Maximum depth of objects which must be reached into | 23 (58)                    | 21 (53)                    |
| Minimum width allowance for passing body            | 23 (58)                    | 27 (69)                    |
| Minimum thickness allowance for passing body        | 13 (33)                    | 16 (41)                    |
| Minimum height allowance for bending or kneeling    | 48 (122)                   | 50 (127)                   |

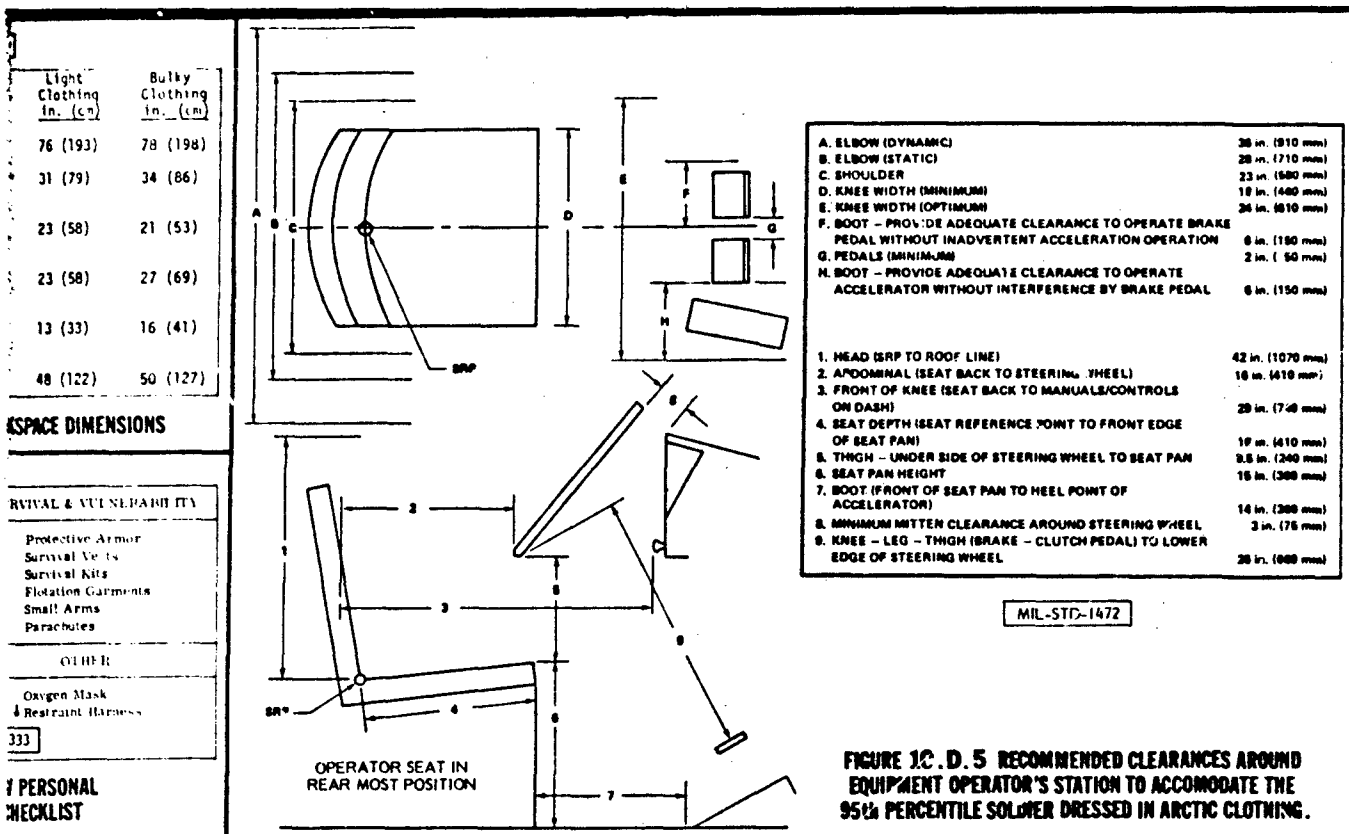
FIGURE 10.D.3 AIRCREW WORKSPACE DIMENSIONS

| PROTECTIVE GARMENTS   | FOOTWEAR  | SURVIVAL & VULNERABILITY  |
|---|---|---|
| Anti-Exposure<br>Anti-G<br>Cold Weather<br>Pressure<br>Ventilation<br>Flight Suit | Shoes<br>Flight Boots<br>Survival Boots<br>Cold Weather | Protective Armor<br>Survival Vests<br>Survival Kits<br>Flotation Garments<br>Small Arms<br>Parachutes |
| HEADGEAR  | HANDWEAR  | OTHER   |
| Protective<br>Pressure<br>Windblast<br>Anti-Radiation                             | Lightweight<br>Cold Weather                             | Oxygen Mask<br>Restraint Harness  |

FIGURE 10.D.4 AIRCREW PERSONAL & SURVIVAL EQUIPMENT CHECKLIST

| WORK AREA OR TYPE OF TASK  | ILLUMINATION LEVELS |                    |
|--|---------------------|--------------------|
|  | MIL-STD-1472        | FOOTCANDLES* (LUX) |
|  | RECOMMENDED         | MINIMUM            |
| Assembly, missile components                                     | 100 (1075)          | 50 (540)           |
| Assembly, general  |                     |                    |
| coarse   | 50 (540)            | 30 (325)           |
| medium   | 75 (810)            | 50 (540)           |
| fine   | 100 (1075)          | 75 (810)           |
| precision  | 200 (2150)          | 200 (2150)         |
| Bench work   |                     |                    |
| rough  | 50 (540)            | 30 (325)           |
| medium   | 75 (810)            | 50 (540)           |
| fine   | 100 (1075)          | 75 (810)           |
| extra fine   | 200 (2150)          | 200 (2150)         |
| Business machine operation<br>(calculator, digital, input, etc.) | 100 (1075)          | 50 (540)           |
| Console surface  | 50 (540)            | 30 (325)           |
| Corridors  | 20 (215)            | 10 (110)           |
| Circuit diagram  | 100 (1075)          | 50 (540)           |
| Dials  | 50 (540)            | 30 (325)           |
| Electrical equipment testing                                     | 50 (540)            | 30 (325)           |
| Emergency lighting   |                     | 3 (30)             |
| Gages  | 50 (540)            | 30 (325)           |
| Hallways   | 20 (215)            | 10 (110)           |





| FOOT CANDLES* (LUX) | WORK AREA OR TYPE OF TASK |            | FOOT CANDLES* (LUX)  |         | WORK AREA OR TYPE OF TASK |          | FOOT CANDLES* (LUX) |         |
|---------------------|---------------------------|------------|--|---------|---------------------------|----------|---------------------|---------|
|                     | RECOMMENDED               | MINIMUM    | RECOMMENDED  | MINIMUM | RECOMMENDED               | MINIMUM  | RECOMMENDED         | MINIMUM |
| 100 (1075)          | 50 (540)                  | 30 (325)   | Inspection tasks, general:   |         | 100 (1075)                | 50 (540) | 30 (325)            |         |
|                     |                           |            | rough  |         |                           |          |                     |         |
|                     |                           |            | medium   |         |                           |          |                     |         |
|                     |                           |            | fine   |         |                           |          |                     |         |
| 50 (540)            | 30 (325)                  | 10 (110)   | extra fine   |         | 50 (540)                  | 30 (325) |                     |         |
|                     |                           |            | Machine operation, automatic   |         |                           |          |                     |         |
|                     |                           |            | Meters   |         |                           |          |                     |         |
|                     |                           |            | Miscellaneous:   |         |                           |          |                     |         |
| 75 (810)            | 50 (540)                  | 30 (325)   | repair and servicing   |         | 75 (810)                  | 50 (540) |                     |         |
|                     |                           |            | storage areas  |         |                           |          |                     |         |
|                     |                           |            | general inspection   |         |                           |          |                     |         |
|                     |                           |            | Office work, general   |         |                           |          |                     |         |
| 100 (1075)          | 50 (540)                  | 30 (325)   | Ordinary sewing tasks  |         | 100 (1075)                | 50 (540) |                     |         |
|                     |                           |            | Paints:  |         |                           |          |                     |         |
|                     |                           |            | front  |         |                           |          |                     |         |
|                     |                           |            | rear   |         |                           |          |                     |         |
| 20 (215)            | 10 (110)                  | 3 (30)     | Passageways  |         | 20 (215)                  | 10 (110) |                     |         |
|                     |                           |            | Reading:   |         |                           |          |                     |         |
|                     |                           |            | large print  |         |                           |          |                     |         |
|                     |                           |            | newsprint  |         |                           |          |                     |         |
| 50 (540)            | 30 (325)                  | 10 (110)   | handwritten reports, in pencil   |         | 50 (540)                  | 30 (325) |                     |         |
|                     |                           |            | small type   |         |                           |          |                     |         |
|                     |                           |            | prolonged reading  |         |                           |          |                     |         |
|                     |                           |            | Recording  |         |                           |          |                     |         |
| 50 (540)            | 30 (325)                  | 10 (110)   | Report mark:   |         | 50 (540)                  | 30 (325) |                     |         |
|                     |                           |            | general  |         |                           |          |                     |         |
|                     |                           |            | instrument   |         |                           |          |                     |         |
|                     |                           |            | Storage:   |         |                           |          |                     |         |
| 5 (55)              | 3 (30)                    | 5 (55)     | inactive or dead   |         | 10 (110)                  | 5 (55)   |                     |         |
|                     |                           |            | general warehouse  |         |                           |          |                     |         |
|                     |                           |            | live, rough or bulk  |         |                           |          |                     |         |
|                     |                           |            | live, medium   |         |                           |          |                     |         |
| 30 (325)            | 20 (215)                  | 50 (540)   | live, fine   |         | 30 (325)                  | 20 (215) |                     |         |
|                     |                           |            | Switchboards   |         |                           |          |                     |         |
|                     |                           |            | Tanks, operations  |         |                           |          |                     |         |
|                     |                           |            | Testing:   |         |                           |          |                     |         |
| 50 (540)            | 30 (325)                  | 100 (1075) | rough  |         | 50 (540)                  | 30 (325) |                     |         |
|                     |                           |            | fine   |         |                           |          |                     |         |
|                     |                           |            | extra fine   |         |                           |          |                     |         |
|                     |                           |            | Transcribing and tabulation  |         |                           |          |                     |         |
| 100 (1075)          | 50 (540)                  | 30 (325)   | NOTE: Some unusual inspection tasks may require up to 1,000 ft-c (10,000 lux)  |         | 100 (1075)                | 50 (540) |                     |         |
|                     |                           |            | NOTE: As a guide in determining illumination requirements the use of a steel scale with 1/64 inch divisions requires 100 foot candles of light for optimum visibility. |         |                           |          |                     |         |
|                     |                           |            | *As measured at the task object or 30 inches (760mm) above the floor.  |         |                           |          |                     |         |
|                     |                           |            |  |         |                           |          |                     |         |

FIGURE 10.E.1 SPECIFIC TASK ILLUMINATION REQUIREMENTS



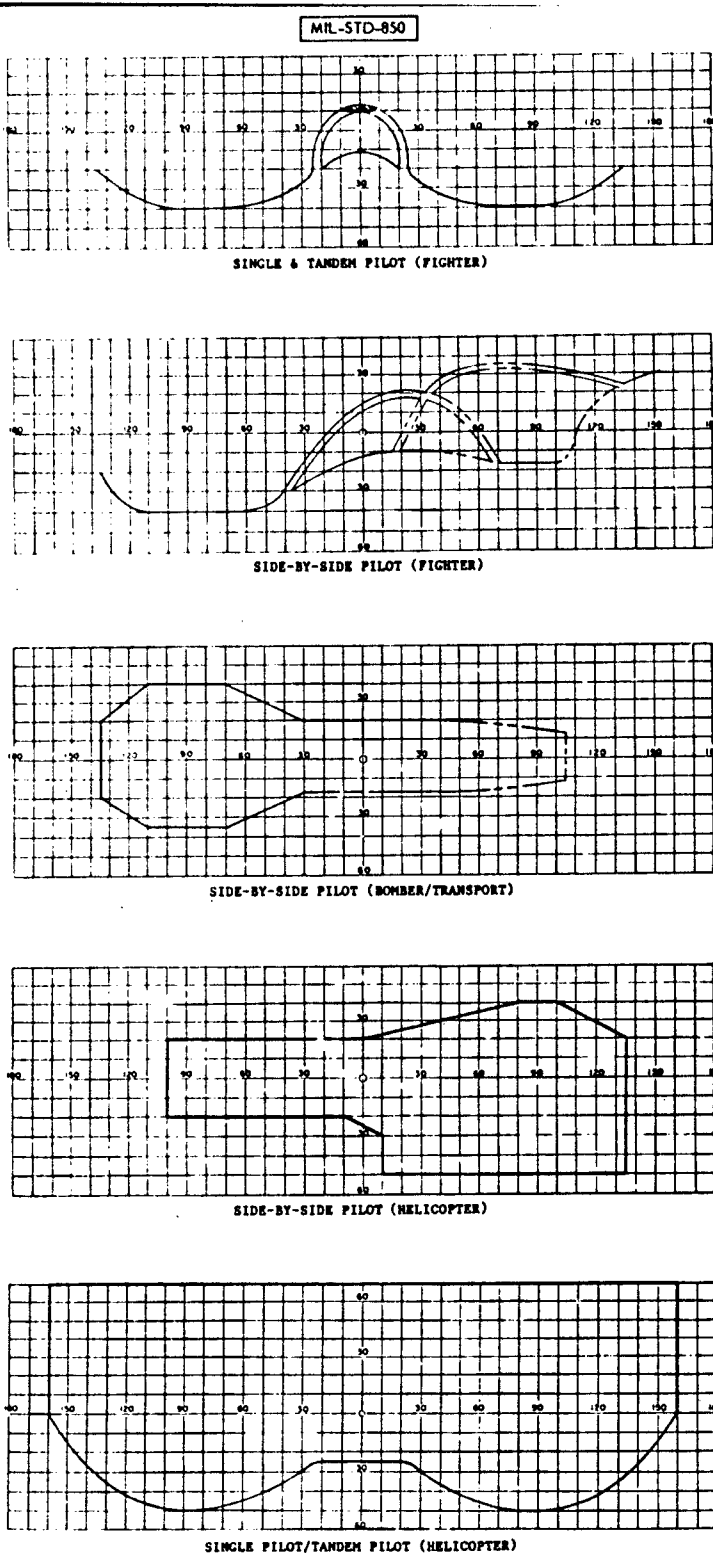


FIGURE 10 E 2 PILOT VISION PLOTS

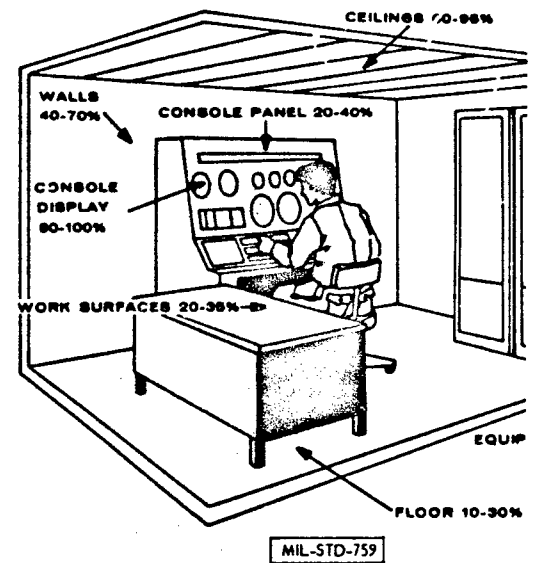


FIGURE 10.E.3 WORKSPACE REFLECTANCE VALUE

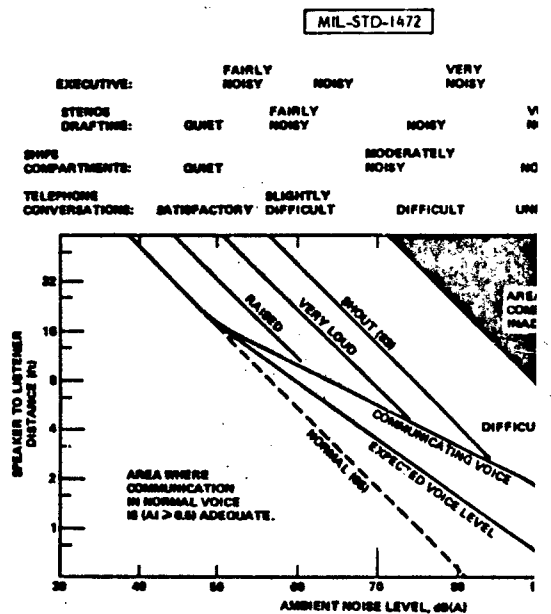
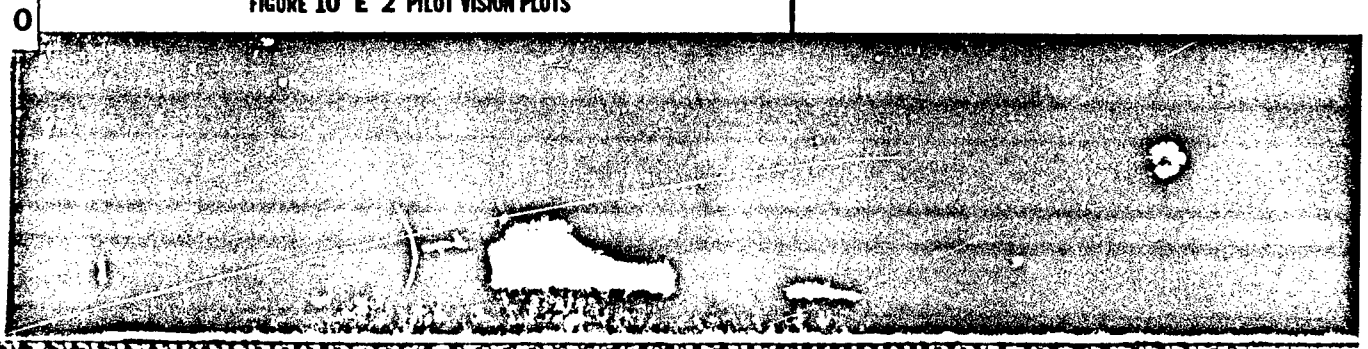
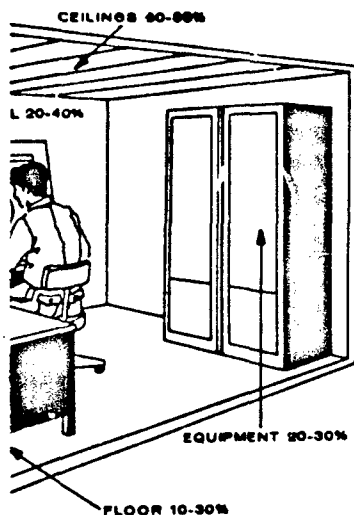


FIGURE 10.F.2 PERMISSIBLE DISTANCE BETWEEN A SPEAKER SPECIFIED VOICE LEVELS AND AMBIENT NOISE L







L-STD-759

# SPACE REFLECTANCE VALUES

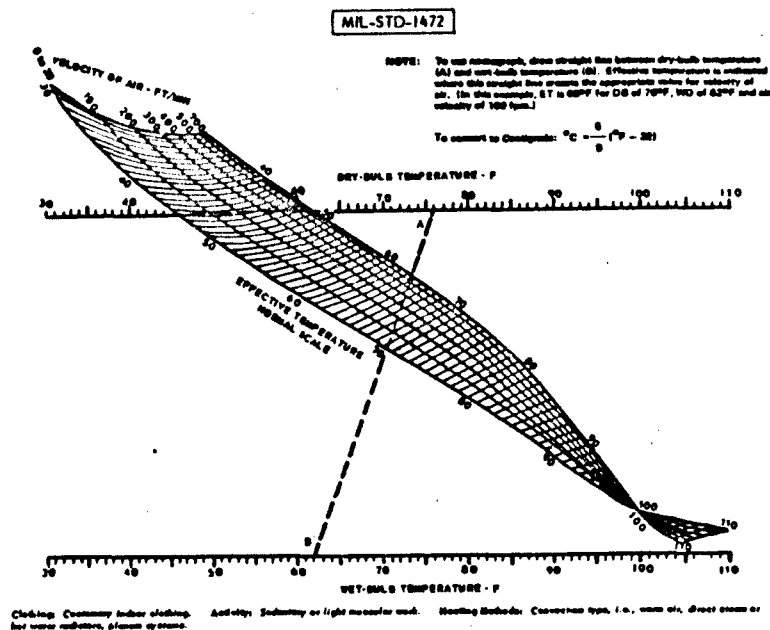
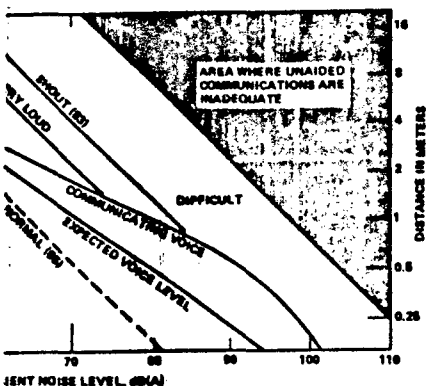


FIGURE 10.F.1 EFFECTIVE TEMPERATURE

MIL-STD-1472

|                  |            |                   |
|------------------|------------|-------------------|
| NOISY            | VERY NOISY | INTOLERABLY NOISY |
| MODERATELY NOISY | VERY NOISY | INTOLERABLY NOISY |
| DIFFICULT        | NOISY      | VERY NOISY        |
| UNSATISFACTORY   |            |                   |



STANCE BETWEEN A SPEAKER AND LISTENERS FOR LEVELS AND AMBIENT NOISE LEVELS

| SYSTEM REQUIREMENT   | CATEGORY |
|--|----------|
| NO DIRECT PERSON-TO-PERSON VOICE COMMUNICATION REQUIRED. MAXIMUM DESIGN LIMIT. HEARING PROTECTION REQUIRED.  | A        |
| SYSTEM REQUIREMENT FOR ELECTRICALLY AIDED COMMUNICATION VIA ATTENUATING HELMET OR HEADSET. NOISE LEVELS ARE HAZARDOUS TO UNPROTECTED EARS.   | B        |
| NO FREQUENT DIRECT PERSON-TO-PERSON VOICE COMMUNICATION REQUIRED. OCCASIONAL SHOUTED COMMUNICATION MAY BE POSSIBLE AT A DISTANCE OF ONE FOOT. HEARING PROTECTION REQUIRED.                                 | C        |
| NO FREQUENT DIRECT PERSON-TO-PERSON VOICE COMMUNICATION REQUIRED. OCCASIONAL SHOUTED COMMUNICATION MAY BE POSSIBLE AT A DISTANCE OF TWO FEET. (LEVELS IN EXCESS OF CATEGORY D REQUIRE HEARING PROTECTION.) | D        |
| OCCASIONAL TELEPHONE USE OR OCCASIONAL DIRECT COMMUNICATION AT DISTANCES UP TO FIVE FEET REQUIRED. (EQUIVALENT TO NC-70.)  | E*       |
| FREQUENT TELEPHONE USE OR FREQUENT DIRECT COMMUNICATION AT DISTANCES UP TO FIVE FEET REQUIRED. (EQUIVALENT TO NC-60)   | F*       |

\* FOR DESIGN OF MOBILE OR TRANSPORTABLE SYSTEMS. FOR FIXED-PLANT FACILITIES, SEE M'L-STD-1472.

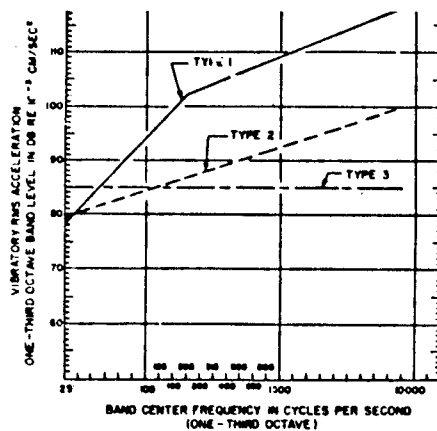
(NOTE: CATEGORIES A, B, C, AND D ARE BASED PRIMARILY ON HEARING CONSERVATION PRIORITIES, WHILE THE REMAINING CATEGORIES ARE BASED PRIMARILY ON COMMUNICATION REQUIREMENTS.)

MIL-STD-1472

FIGURE 10.F.3 STEADY-STATE NOISE LIMITS FOR CATAGORIES OF PERSONNEL OCCUPIED AREAS







#### CORRECTION FACTORS

FOR FUNDAMENTAL FREQUENCIES BELOW 2500 Hz, EXTRAPOLATE TO THE REQUIRED LEVEL.

FOR TYPE 2 NON-SEA CONNECTED PUMP, ADD 500 TO THE STATED ACCEPTANCE CRITERIA.

FOR SOLIDLY MOUNTED EQUIPMENT, SUBTRACT 2000 FROM THE CURVES.

LIFE SUPPORT EQUIPMENT (I.E. OXYGEN GENERATOR, CO<sub>2</sub> SCRUBBER, H<sub>2</sub>-CO BURNER AND DISTILLING UNITS), SUBTRACT 2000 FROM TYPE 3.

FOR VIBRATIONAL PANS, SHALL BE AT THE FOLLOWING ACCEPTANCE CRITERIA:  
FOR LESS THAN 2HP SUBTRACT 25DB FROM TYPE 3  
FOR 2HP UP TO 10HP SUBTRACT 15DB FROM TYPE 3  
ABOVE 10HP SUBTRACT 5DB FROM TYPE 3

Type 1 equipment. - All compressors and internal combustion engines

Type 2 equipment. - All pumps

Type 3 equipment. - All other equipment

MIL-STD-740

FIGURE 10.F.4 SHIP STRUCTUREBORNE NOISE ACCEPTANCE LEVELS

| Airborne Noise Category | Center frequencies of standard octave bands (c.p.s.) | SIL value |
|-------------------------|--|-----------|
|                         | 32 63 125 250 500 1000 2000 4000 8000                |           |
| A                       | 115 110 105 100 SIL value requirement 85             | 85 64     |
| B                       | 90 86 79 76 73 71 70 69 68                           | --        |
| C                       | 85 78 72 68 65 62 60 58 57                           | --        |
| D                       | 115 110 105 100 90 85 85 85 85                       | --        |
| E                       | 115 110 105 100 SIL value requirement 85             | 85 72     |
| F                       | 115 110 105 100 SIL value requirement 85             | 85 63     |

#### Airborne Noise Categories

Category A: Spaces, other than Category E spaces, where intelligible speech communication is necessary.

Category B: Spaces where comfort of personnel in their quarters is normally considered to be an important factor.

Category C: Spaces where it is essential to maintain especially quiet conditions.

Category D: Spaces or areas where a higher noise level is expected and where deafness avoidance is a greater consideration than intelligible speech communication.

Category E: High noise level areas where intelligible speech communication is necessary.

Category F: Topside operating stations on weather decks where intelligible speech communication is necessary.

#### Speech Interference Level (SIL)

Measure of the effect of airborne background noise on intelligible speech communication. Numerically, it is the arithmetical average of the sound pressure level, in decibels, in the octave bands with center frequencies of 500, 1000, and 2000 c.p.s.

RUSHIPS-SPEC-1-10

FIGURE 10.F.7 AIRBORNE NOISE LEVELS FOR SHIP COMPARTMENTS (IN DECIBELS)

| type                              | DEFINITION   | examples   |
|-----------------------------------|--|--|
| General Workspaces                | Areas requiring occasional telephone use or occasional direct communications at distances up to five feet. (1.520 m).                  | Maintenance shops and shelters, garages, ke punch areas, shipboard engineering areas.  |
| Operational Areas                 | Areas requiring frequent telephone use or frequent direct communication at distances up to five feet. (1.520 m).                       | Operation centers, mobile command and communication shelters, combat information centers, computer room word processing centers. |
| Large Workspaces                  | Areas requiring no difficulty with telephone use or requiring occasional direct communication at distances up to five feet. (4.570 m). | Drafting rooms, shop offices, laboratories.  |
| Small Office Spaces/Special Areas | Areas requiring no difficulty with direct communication.   | Conference rooms, libraries, offices, command and control centers.   |
| Extreme Quiet Areas               | Areas requiring unusually extreme quiet.   | Recording studios.   |

dB(A) - The A-weight network of a sound meter.

PSIL-4 - The arithmetic mean of sound pressure levels in the four frequencies of 500, 1000, 2000, and 4000 Hz.

PSIL - The arithmetic means of sound pressure levels in the center frequencies of 500, 1000 and 2000 Hz.

MIL-STD-740

FIGURE 10.F.5 NON-HAZARDOUS WORKSPACE I

#### MAXIMUM ACCEPTABLE NOISE LEVEL IN AIRCRAFT CONTINUOUS POWER

| PREFERRED       |        |                                  | Frequency band (cps) |
|-----------------|--------|----------------------------------|----------------------|
| Frequency (cps) |        | Max. acceptable noise level (db) |                      |
| Band            | Center |                                  |                      |
| Overall         |        | 113                              | Overall              |
| 22.4 - 45       | 31.5   | 111                              | 37.5 - 71            |
| 45 - 90         | 63     | 111                              | 75 - 154             |
| 90 - 180        | 125    | 111                              | 150 - 304            |
| 180 - 355       | 250    | 111                              | 300 - 604            |
| 355 - 710       | 500    | 105                              | 600 - 1204           |
| 710 - 1400      | 1000   | 99                               | 1200 - 2404          |
| 1400 - 2800     | 2000   | 93                               | 2400 - 4804          |
| 2800 - 5600     | 4000   | 87                               | 4800 - 9604          |
| 5600 - 11200    | 8000   | 87                               |                      |

#### MAXIMUM ACCEPTABLE NOISE LEVEL IN AIRCRAFT UNDER CONDITIONS (LESS THAN 5 MINUTES)

| PREFERRED       |        |                                  | Frequency band (cps) |
|-----------------|--------|----------------------------------|----------------------|
| Frequency (cps) |        | Max. acceptable noise level (db) |                      |
| Band            | Center |                                  |                      |
| Overall         |        | 120                              | Overall              |
| 22.4 - 45       | 31.5   | 118                              | 37.5 - 71            |
| 45 - 90         | 63     | 118                              | 75 - 154             |
| 90 - 180        | 125    | 118                              | 150 - 304            |
| 180 - 355       | 250    | 118                              | 300 - 604            |
| 355 - 710       | 500    | 112                              | 600 - 1204           |
| 710 - 1400      | 1000   | 106                              | 1200 - 2404          |
| 1400 - 2800     | 2000   | 100                              | 2400 - 4804          |
| 2800 - 5600     | 4000   | 94                               | 4800 - 9604          |
| 5600 - 11200    | 8000   | 94                               |                      |



|   |   |      |      |      |
|---|---|------|------|------|
| Occasional<br>noise at<br>five feet.          | Maintenance shops and<br>shelters, garages, key<br>punch areas, shipboard<br>engineering areas  | 75dB | 67dB | 68dB |
| Frequent<br>noise at<br>five feet.            | Operation centers,<br>mobile command and com-<br>munication shelters,<br>combat information<br>centers, computer rooms,<br>word processing centers. | 65dB | 57dB | 58dB |
| Diffi-<br>culty use<br>noise at<br>five feet. | Drafting rooms, shop<br>offices, laboratories   | 55dB | 47dB | 48dB |
| Diffi-<br>culty com-<br>munication            | Conference rooms,<br>libraries, offices,<br>command and control<br>centers.   | 45dB | 37dB | 48dB |
| Usually                                       | Recording studios   | 35dB | 27dB | 28dB |

a sound meter.

und pressure levels in the four octave bands with center  
2000, and 4000 Hz.

sound pressure levels in the three octave bands with  
1000 and 2000 Hz.

MIL-STD-740

## NON-HAZARDOUS WORKSPACE NOISE

| Airborne<br>grade | Sound power levels, ref. 10 <sup>-12</sup> watts per center<br>frequency of standard octave bands Hz |     |     |     |  |      |      |      |      |
|-------------------|--|-----|-----|-----|--|------|------|------|------|
|                   | 31.5   | 63  | 125 | 250 | 500  | 1000 | 2000 | 4000 | 8000 |
| A                 |  |     |     |     | Numerical average of<br>500, 1000 and 2000 Hz<br>bands - 71 db |      |      |      |      |
| B                 | 97   | 91  | 86  | 82  | 79   | 78   | 77   | 76   | 75   |
| C                 | 92   | 84  | 79  | 74  | 71   | 68   | 67   | 65   | 64   |
| D                 | 122  | 117 | 113 | 107 | 97   | 92   | 92   | 92   | 92   |

Grade A equipment. - Grade A equipment is any item of equipment which will be placed in spaces  
where intelligible speech communication is frequently required and minimum vocal effort by the speaker is a  
consideration.

Grade B equipment. - Grade B equipment is any item of equipment which will be placed in spaces  
where comfort of personnel in their quarters is the principle consideration.

Grade C equipment. - Grade C equipment is any item of equipment which will be placed in spaces  
where function requires minimum annoyance to working personnel.

Grade D equipment. - Grade D equipment is any item of equipment which will be placed in spaces  
where distress avoidance is the prime consideration and intelligible speech communication is not normally  
required.

MIL-STD-740

FIGURE 10.F.6 AIRBORNE NOISE ACCEPTANCE LEVELS  
FOR SHIP EQUIPMENT (IN DECIBELS)

## ACCEPTABLE NOISE LEVEL IN AIRCRAFT AT MAXIMUM CONTINUOUS POWER

| Frequency (cps) | MAXIMUM                                  |  |
|-----------------|--|--|
|                 | Max. accept-<br>able noise<br>level (db) | Max. accept-<br>able noise<br>level (db) |
| Overall         | 113                                      | 113                                      |
| 22.4 - 45       | 111                                      | 111                                      |
| 45 - 90         | 111                                      | 111                                      |
| 90 - 180        | 111                                      | 111                                      |
| 180 - 355       | 111                                      | 111                                      |
| 355 - 710       | 111                                      | 111                                      |
| 710 - 1400      | 105                                      | 105                                      |
| 1400 - 2800     | 99                                       | 99                                       |
| 2800 - 5600     | 93                                       | 93                                       |
| 5600 - 11200    | 87                                       | 87                                       |

## MAXIMUM ACCEPTABLE NOISE LEVEL WITH PROTECTIVE HELMETS OR DEVICES

| PREFERRED       |  | MAXIMUM                  |  |
|-----------------|--|--------------------------|--|
| Frequency (cps) | Max. accept-<br>able noise<br>level (db) | Frequency bands<br>(cps) | Max. accept-<br>able noise<br>level (db) |
| Overall         | 108                                      | Overall                  | 108                                      |
| 22.4 - 45       | 104                                      | 37.5 - 75                | 104                                      |
| 45 - 90         | 104                                      | 75 - 150                 | 104                                      |
| 90 - 180        | 104                                      | 150 - 300                | 104                                      |
| 180 - 355       | 104                                      | 300 - 600                | 98                                       |
| 355 - 710       | 98                                       | 600 - 1200               | 90                                       |
| 710 - 1400      | 90                                       | 1200 - 2400              | 86                                       |
| 1400 - 2800     | 86                                       | 2400 - 4800              | 75                                       |
| 2800 - 5600     | 75                                       | 4800 - 9600              | 75                                       |
| 5600 - 11200    | 75                                       |                          |  |

## MAXIMUM ACCEPTABLE NOISE LEVEL AT NORMAL CRUISE POWER

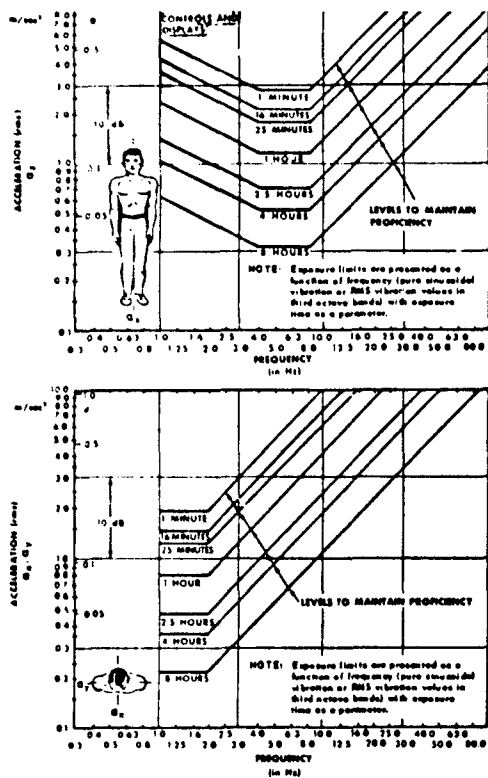
| Frequency (cps) | MAXIMUM                                  |  |
|-----------------|--|--|
|                 | Max. accept-<br>able noise<br>level (db) | Max. accept-<br>able noise<br>level (db) |
| Overall         | 120                                      | 120                                      |
| 22.4 - 45       | 118                                      | 118                                      |
| 45 - 90         | 118                                      | 118                                      |
| 90 - 180        | 118                                      | 118                                      |
| 180 - 355       | 118                                      | 118                                      |
| 355 - 710       | 112                                      | 112                                      |
| 710 - 1400      | 106                                      | 106                                      |
| 1400 - 2800     | 100                                      | 100                                      |
| 2800 - 5600     | 94                                       | 94                                       |
| 5600 - 11200    | 94                                       | 94                                       |

| PREFERRED       |  | MAXIMUM                  |  |
|-----------------|--|--------------------------|--|
| Frequency (cps) | Max. accept-<br>able noise<br>level (db) | Frequency bands<br>(cps) | Max. accept-<br>able noise<br>level (db) |
| Overall         | 113                                      | Overall                  | 113                                      |
| 22.4 - 45       | 111                                      | 37.5 - 75                | 111                                      |
| 45 - 90         | 111                                      | 75 - 150                 | 111                                      |
| 90 - 180        | 111                                      | 150 - 300                | 111                                      |
| 180 - 355       | 111                                      | 300 - 600                | 108                                      |
| 355 - 710       | 108                                      | 600 - 1200               | 106                                      |
| 710 - 1400      | 106                                      | 1200 - 2400              | 100                                      |
| 1400 - 2800     | 100                                      | 2400 - 4800              | 94                                       |
| 2800 - 5600     | 94                                       | 4800 - 9600              | 94                                       |
| 5600 - 11200    | 94                                       |                          |  |

MIL-A-8806

FIGURE 10.F.8 AIRCRAFT NOISE LEVELS





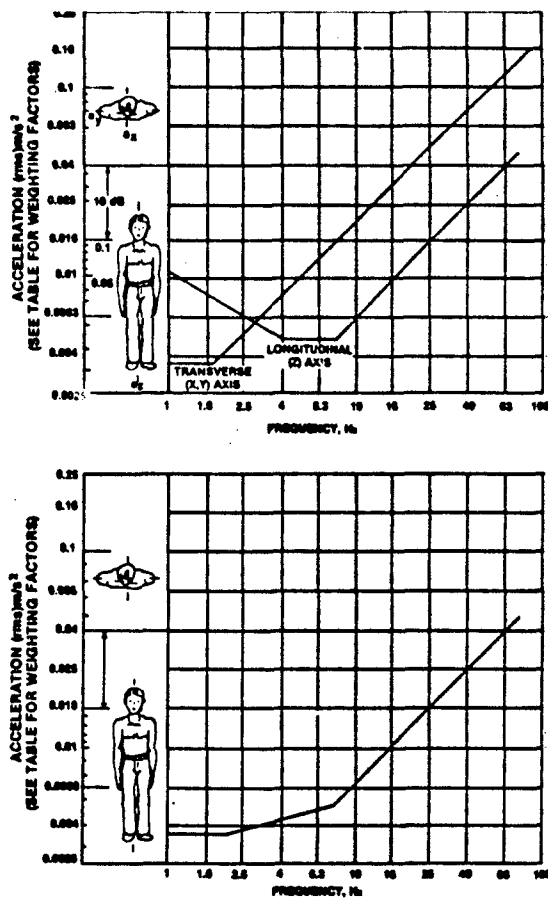
If comfort is to be maintained, these acceleration values are divided by 3.15.  
To protect human health, whole body vibration does not exceed twice (6 dB) the acceleration values shown for the time and frequencies indicated.

**FIGURE 10.F.9 VIBRATION EXPOSURE CRITERIA FOR LONGITUDINAL (UPPER CURVE) AND TRANSVERSE (LOWER CURVE) DIRECTIONS WITH RESPECT TO BODY AXIS**

**Impulse noise levels.** The impulse noise levels associated with the operation of the escape system, and measured at the ears of a 50th percentile aircrewman seated with his eyes at the design eye position in each aircrew station, shall not exceed the damage risk criterion proposed in the Report of Working Group 87, National Academy of Sciences - National Research Council, Council Committee on Hearing Bioacoustics, and Biomechanics (CHABA), July 1968, for impulse noise of B-duration type. Since the probable maximum exposure of any aircrewman to repeated-impulse noise is limited to a minimal number of impulses occurring during the operation of the escape system, the damage risk criterion may be corrected to permit an additional 10dB. If all crewmen will be equipped with APH-6 or APH-6 helmet with Gentax Sonic ear cups (for ear protection deemed by the G. command procuring activity to be equivalent), an additional correction may be made to the damage risk criterion to permit an increase of 20dB.

MIL-S-18471

**FIGURE 10.F.10 EJECTION SYSTEM IMPULSE NOISE LEVELS**



| PLACE   | TIME         | CONTINUOUS OR INTERMITTENT VIBRATION AND REPEATED IMPULSIVE SHOCK | IMPULSIVE SHOCK EXCITATION WITH APPROXIMATELY THREE OCCURRENCES/DAY |
|---|--------------|---|---|
| HOSPITAL OPERATING THEATRE AND CRITICAL WORKING AREAS | DAY<br>NIGHT | 1<br>1  | 1<br>1  |
| RESIDENTIAL (MINIMUM COMPLAINT LEVEL)                 | DAY<br>NIGHT | 2<br>1.4  | 18<br>7.4   |
| OFFICE  | DAY<br>NIGHT | 4<br>4  | 120<br>120  |
| WORKSHOP  | DAY<br>NIGHT | 5<br>3  | 120<br>120  |

WEIGHTING FACTORS FOR ACCEPTABLE BUILDING VIBRATION WITH RESPECT TO HUMAN RESPONSE

MIL-STD-1472

**FIGURE 10.F.11 BUILDING VIBRATION EXPOSURE CRITERIA FOR LONGITUDINAL AND TRANSVERSE (UPPER CURVE) AND COMBINED (LOWER CURVE) DIRECTIONS WITH RESPECT TO BODY AXIS. WEIGHTING FACTORS FOR ACCEPTABLE BUILDING VIBRATION WITH RESPECT TO HUMAN RESPONSE**

\* A SIN  
NON-  
IMPU-  
REPE-  
IMPU-  
\* HIGH-  
OTHER

PEAK PRESSURE LEVEL  
(dB re 20 µPa)

FIGURE 10.G

MEASURED DISTANCE (METERS)

|       |
|-------|
| 1-1/4 |
| 2     |
| 3     |
| 4     |
| 6     |
| 10    |
| 15    |
| 20    |
| 25    |
| 30    |
| 35    |
| 40    |
| 45    |
| 50    |
| 55    |
| 60    |
| 65    |
| 70    |
| 75    |
| 80    |
| 85    |
| 90    |
| 95    |
| 100   |

**FIGURE 10.G**

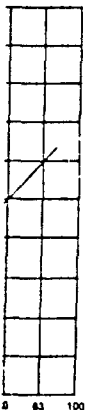
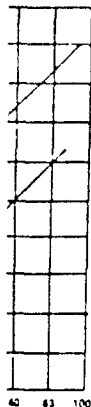
Dist.

These values of whether exposure is considered following

exceeds an threshold specified permitted

FIGURE 10.H





|      | PROTECTION | OR MUFFS | AND MUFFS |
|------|------------|----------|-----------|
| 1000 | W          | X        | Y         |
| 100  | W          | Y        | Z         |
| 5    | W          | Z        | Z**       |

\* A SINGLE EXPOSURE CONSISTS OF EITHER (a) A SINGLE PULSE FOR NON-REPETITIVE SYSTEMS (SYSTEMS PRODUCING LESS THAN ONE IMPULSE PER SECOND), OR (b) A SERIES OF PULSES (e.g., A PULSE FOR REPETITIVE SYSTEMS) WHICH IS NORMALLY PRODUCING MORE THAN ONE IMPULSE PER SECOND, e.g., AUTOMATIC WEAPON.

\*\* HIGHER LEVELS THAN CURVE Z NOT PERMITTED DUE TO POSSIBILITY OF OTHER NON-AUDITORY PHYSIOLOGICAL INJURY

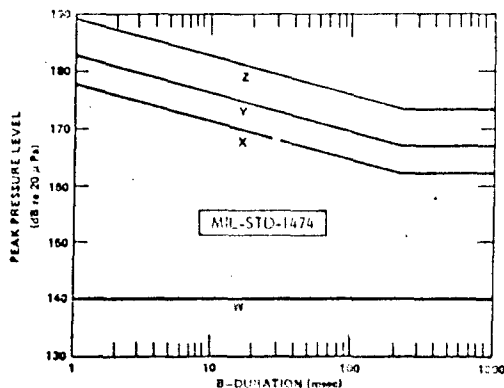


FIGURE 10.G.1 PEAK PRESSURE LEVEL AND D-DURATION LIMITS FOR IMPULSE NOISE

MIL-STD-1474

| MEASUREMENT DISTANCE (METERS) | CENTER FREQUENCY (Hz) |     |     |     |    |    |    |    | NOMINAL HORN-TO-EAR STABILITY (DISTANCE METERS) |
|-------------------------------|-----------------------|-----|-----|-----|----|----|----|----|---|
|                               | 63                    | 125 | 250 | 500 | 1K | 2K | 4K | 8K |   |
| 1 1/4                         | 48                    | 34  | 32  | 32  | 32 | 32 | 32 | 32 | 5   |
| 2                             | 50                    | 36  | 34  | 34  | 34 | 34 | 34 | 34 | 10  |
| 3                             | 52                    | 38  | 36  | 36  | 36 | 36 | 36 | 36 | 15  |
| 4                             | 54                    | 40  | 38  | 38  | 38 | 38 | 38 | 38 | 20  |
| 6                             | 56                    | 42  | 40  | 40  | 40 | 40 | 40 | 40 | 30  |
| 10                            | 58                    | 44  | 42  | 42  | 42 | 42 | 42 | 42 | 50  |
| 15                            | 60                    | 46  | 44  | 44  | 44 | 44 | 44 | 44 | 75  |
| 20                            | 62                    | 48  | 46  | 46  | 46 | 46 | 46 | 46 | 100   |
| 25                            | 64                    | 50  | 48  | 48  | 48 | 48 | 48 | 48 | 150   |
| 30                            | 66                    | 52  | 50  | 50  | 50 | 50 | 50 | 50 | 200   |
| 35                            | 68                    | 54  | 52  | 52  | 52 | 52 | 52 | 52 | 300   |
| 40                            | 70                    | 56  | 54  | 54  | 54 | 54 | 54 | 54 | 400   |
| 45                            | 72                    | 58  | 56  | 56  | 56 | 56 | 56 | 56 | 500   |
| 50                            | 74                    | 60  | 58  | 58  | 58 | 58 | 58 | 58 | 750   |
| 55                            | 76                    | 62  | 60  | 60  | 60 | 60 | 60 | 60 | 1000  |
| 60                            | 78                    | 64  | 62  | 62  | 62 | 62 | 62 | 62 | 1500  |
| 65                            | 80                    | 66  | 64  | 64  | 64 | 64 | 64 | 64 | 2000  |
| 70                            | 82                    | 68  | 66  | 66  | 66 | 66 | 66 | 66 | 3000  |
| 75                            | 84                    | 70  | 68  | 68  | 68 | 68 | 68 | 68 | 4000  |
| 80                            | 86                    | 72  | 70  | 70  | 70 | 70 | 70 | 70 | 5000  |
| 85                            | 88                    | 74  | 72  | 72  | 72 | 72 | 72 | 72 | 7500  |
| 90                            | 90                    | 76  | 74  | 74  | 74 | 74 | 74 | 74 | 10000   |
| 95                            | 92                    | 78  | 76  | 76  | 76 | 76 | 76 | 76 | 15000   |
| 100                           | 94                    | 80  | 78  | 78  | 78 | 78 | 78 | 78 | 20000   |

\* SLANT RANGE FROM NOISE SOURCE TO MICROPHONE

FIGURE 10.G.2 AURAL NON-DETECTABILITY LIMITING OCTAVE BAND LEVEL

| Duration Per Day in Hours | Sound Level dBA |
|---------------------------|-----------------|
| 8                         | 90              |
| 6                         | 92              |
| 4                         | 95              |
| 3                         | 97              |
| 2                         | 100             |
| 1-1/2                     | 102             |
| 1                         | 105             |
| 1/2                       | 110             |
| 1/4 or less               | 115             |

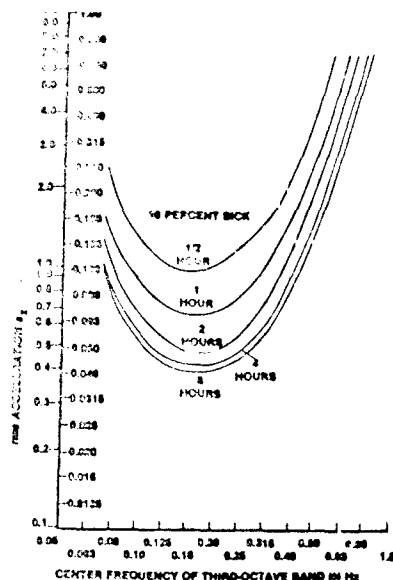
These values apply to total time of exposure per working day regardless of whether this is one continuous exposure or a number of short-term exposure but does not apply to impact or impulsive type of noises.

When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions:

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \dots + \frac{C_n}{T_n}$$

exceeds unity, then the mixed exposure should be considered to exceed the threshold limit value.  $C_i$  indicates the total time of exposure at a specified noise level, and  $T_i$  indicates the total time of exposure permitted at that level.

FIGURE 10.G.3 TOTAL NOISE EXPOSURE FOR AN 8-HOUR DAY



MIL-STD-1472

FIGURE 10.G.4 THE 90 PERCENT MOTION SICKNESS

| COMMUNICATION REQUIREMENT   | SCORE |     |     |
|---|-------|-----|-----|
|   | PB    | MRT | AI  |
| Exceptionally high intelligibility, separate syllables understood   | 90%   | 97% | 0.7 |
| Normally acceptable intelligibility, about 1% of sentences correctly heard, single digits understood  | 75%   | 91% | 0.5 |
| Minimally acceptable intelligibility, limited standard test phrases understood, about 12% sentences correctly heard (in acceptable for operational equipment) | 43%   | 78% | 0.3 |

NOTE: When information concerning the speech intelligibility of a system is required, three recommended methods are available, with the appropriate selection being dependent upon the requirements of the test:

a. The ANSI standard method of measurement of phonetically balanced (PB) monosyllable word intelligibility, S3.2-1960, should be used when a high degree of sensitivity and accuracy is required.

b. The modified rhyme test (MRT) (see Human Engineering Guide to Equipment Design) should be used if the test requirements are not as stringent or if time and training do not permit the use of the ANSI method.

c. The articulation index (AI) calculations should be used for estimations, comparisons and predictions of system intelligibility based upon ANSI S3.5-1969.

MIL-STD-1472

FIGURE 11.H.1 INTELLIGIBILITY CRITERIA FOR VOICE COMMUNICATIONS SYSTEMS

IMPULSIVE SHOCK  
CITATION WITH  
APPROXIMATELY THREE  
CURRENCES/DAY

|     |
|-----|
| 1   |
| 1.6 |
| 1.4 |
| 128 |
| 128 |
| 128 |
| 128 |

CRITERIA  
AND  
EFFECT TO  
BLE  
SPONSE



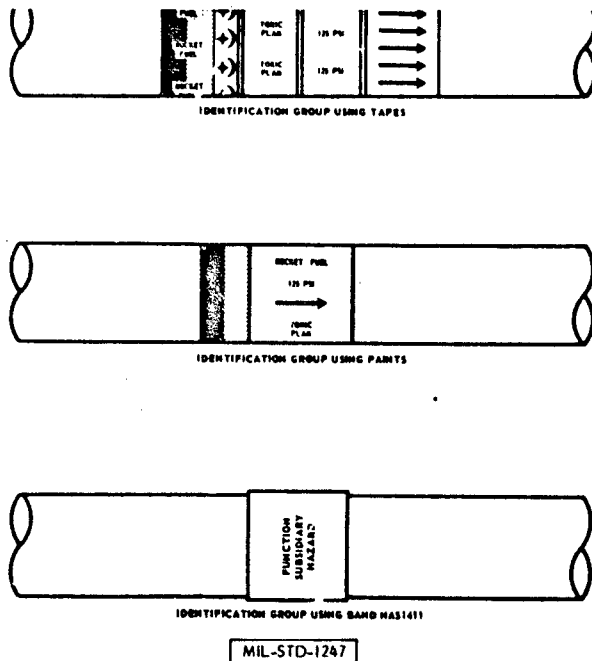


FIGURE 12.H.1 EXAMPLES OF IDENTIFICATION GROUPS

FIGURE 12.H.2 APPLICATION CODE

|                    |     |
|--------------------|-----|
| Pool               | Ree |
| Rocket Outfitter   | Gr  |
| Rocket Pool        | Re  |
| Water Injection    | Re  |
| Lubrication        | Yel |
| Hydraulic          | Bl  |
| Solvent            | Bl  |
| Pneumatic Air      | Or  |
| Instrument Air     | Or  |
| Coolant            | Gr  |
| Breathing Oxygen   | Bl  |
| Air Conditioning   | Gr  |
| Nonpropellant      | Yel |
| Battery Activator  | Yel |
| Rain Repellents    | Bl  |
| Var. Am.           | Gr  |
| Fire Protection    | Gr  |
| De-Icing           | Gr  |
| Rocket Catalyst    | Yel |
| Compressed Gas     | Or  |
| Electrical Conduit | Gr  |
| Inerting Fluid     | Or  |

Color

Blue

Green

Yellow

Orange

Red

Brown

Gray

Black

MIL-STD-1247

FIGURE 12.H.2 APPLICATION CODE

FIGURE 12.H.4 HAZARD IDENTIFICATION MARKING

| CLASS OF HAZARD  | IDENTIFICATION MARKING | MIL-STD-101 COLOR |
|--|------------------------|-------------------|
| <b>Flammable materials.</b> All materials known ordinarily as flammable or combustibles.   | FLAM-----              | Yellow            |
| <b>Toxic and poisonous materials.</b> All materials extremely hazardous to life or health, under normal conditions, as toxics or poisons.  | TOXIC-----             | Brown             |
| <b>Anesthetics and harmful materials.</b> All materials productive of anaesthetic vapors and all liquid chemicals and compounds hazardous to life and property but not normally productive of dangerous quantities of fumes or vapors. | ANES-----              | Blue              |
| <b>Oxidizing materials.</b> All materials which readily furnish oxygen for combustion and fire producers which react explosively or with evolution of heat in contact with any other materials.  | OXYN-----              | Green             |
| <b>Physically dangerous materials.</b> All materials, not dangerous in themselves, which are asphyxiating in confined areas or which are generally handled in a dangerous physical state pressure or temperature.                      | PHDAN-----             | Gray              |
| <b>Fire protection materials.</b> All materials provided in piping systems or in compressed gas cylinders exclusively for use in fire protection.  | FFH-----               | Red               |

MIL-STD-1247

FIGURE 12.H.5 ELECTRICAL CABLE CODING

| Instructions  | Number of Conductor | Basic Color | Tracer |
|---|---------------------|-------------|--------|
| 1. Find the number of the conductor to be color coded | 1                   | Black       | None   |
|   | 2                   | White       | None   |
|   | 3                   | Red         | None   |
|   | 4                   | Green       | None   |
|   | 5                   | Orange      | None   |
|   | 6                   | Blue        | None   |
|   | 7                   | White       | Black  |
|   | 8                   | Red         | Black  |
|   | 9                   | Green       | Black  |
|   | 10                  | Orange      | Black  |
|   | 11                  | Blue        | Black  |
|   | 12                  | Black       | White  |
|   | 13                  | Red         | White  |
|   | 14                  | Green       | White  |
|   | 15                  | Blue        | White  |
|   | 16                  | Black       | Red    |
|   | 17                  | White       | Red    |
|   | 18                  | Orange      | Red    |
|   | 19                  | Blue        | Red    |
|   | 20                  | Red         | Green  |
|   | 21                  | Orange      | Green  |

If a cable has concentrically laid conductors, the first combination of color applies to the center conductor. If a cable contains various sizes of conductors, the first color applies to the largest, continuing in order of conductor size.

MIL-HDBK-759

FIGURE 12

| Function             | Color |
|----------------------|-------|
| Intensified pressure | Bl    |
| Supply pressure      | Re    |
| Charging pressure    | Re    |
| Reduced pressure     | Re    |
| Metered flow         | Yel   |
| Exhaust              | Bl    |
| Intake               | Gr    |
| Drain                | Gr    |
| Inactive             | Bl    |



| Color              |  |
|--------------------|--|
| Red                |  |
| Green, Gray        |  |
| Red, Gray          |  |
| Red, Gray, Red     |  |
| Yellow             |  |
| Blue, Yellow       |  |
| Blue, Brown        |  |
| Orange, Blue       |  |
| Orange, Gray       |  |
| Blue               |  |
| Green              |  |
| Brown, Gray        |  |
| Yellow, Orange     |  |
| Yellow, Gray       |  |
| Blue, Gray         |  |
| Gray, Orange, Gray |  |
| Brown              |  |
| Gray               |  |
| Yellow, Green      |  |
| Orange             |  |
| Brown, Orange      |  |
| Orange, Green      |  |

FED-STD-595  
Code No.

|       |
|-------|
| 15102 |
| 14187 |
| 13655 |
| 12197 |
| 11136 |
| 10049 |
| 16473 |
| 17038 |

MIL-STD-1247

FIGURE 12.H.2 APPLICATION COLORS

|                    |                                 |    |
|--------------------|---------------------------------|----|
| ROCKET CATALYST    | VERTICAL STRIPES                |    |
| ROCKET FUEL        | FOUR-POINT STAR INSIDE CRESCENT | ✦  |
| FUEL               | FOUR-POINT STAR                 | ✦  |
| WATER INJECTION    | INVERTED CHEVRONS               | >  |
| LUBRICATION        | STAGGERED SQUARES               | ■  |
| HYDRAULIC          | CIRCLE                          | ●  |
| COMPRESSED GAS     | BROAD DIAGONAL STRIPE           | \\ |
| INSTRUMENT AIR     | CONTINUOUS ZIG-ZAG LINE         | ~  |
| COOLANT            | HORIZONTAL S                    | /  |
| BREATHING OXYGEN   | RECTANGLE                       | ■  |
| AIR CONDITIONING   | GRAVEL PATTERN                  | ■  |
| FIRE PROTECTION    | HORIZONTAL DIAMOND              | ◆  |
| DE-ICING           | STAGGERED TRIANGLES             | ▲  |
| PNEUMATIC          | CONTINUOUS X-FORM LATTICE       | ✕  |
| ELECTRICAL CONDUIT | FLASH OF LIGHTNING              | ⚡  |
| INERTING FLUID     | STAGGERED PIPE CROSSES          | ✕  |
| SOLVENT            | HORIZONTAL STRIPES              |    |
| MONOPROPELLANT     | BLOCK T                         | T  |
| VACUUM             | VERTICAL WAVY LINE              | ~  |
| BATTERY ACTIVATOR  | SPARKLING                       | ✦  |
| RAIN REPELLENT     | RAIN DROPS                      | ⬇  |

FIGURE 12.H.3 FUNCTIONS AND ASSOCIATED SYMBOLS

| Tracer | Function             | Color            | Definition of Function  |
|--------|----------------------|------------------|---|
| None   | Intensified pressure | Black            | Pressure in excess of supply pressure induced by a booster or intensifier.                        |
| None   | Supply pressure      | Red              | Pressure of the power-actuating fluid.  |
| None   | Charging pressure    | Intermittent Red | Pump-inlet pressure, higher than atmospheric pressure.  |
| None   | Reduced pressure     | Intermittent Red | Auxiliary pressure lower than supply pressure.  |
| Black  | Filtered flow        | Yellow           | Fluid at a controlled flow rate (other than pump delivery).                                       |
| Black  | Exhaust              | Blue             | Return of the power-actuating fluid to reservoir.   |
| Black  | Intake               | Green            | Sub-atmospheric pressure, usually on the intake side of the pump.                                 |
| Black  | Drain                | Green            | Return of leakage of control-actuating fluid to reservoir.  |
| White  | Inactive             | Blank            | Fluid within the circuit but not serving a functional purpose during the phase being represented. |

MIL-HDBK-759

FIGURE 12.H.6 HYDRAULIC AND PNEUMATIC CODING

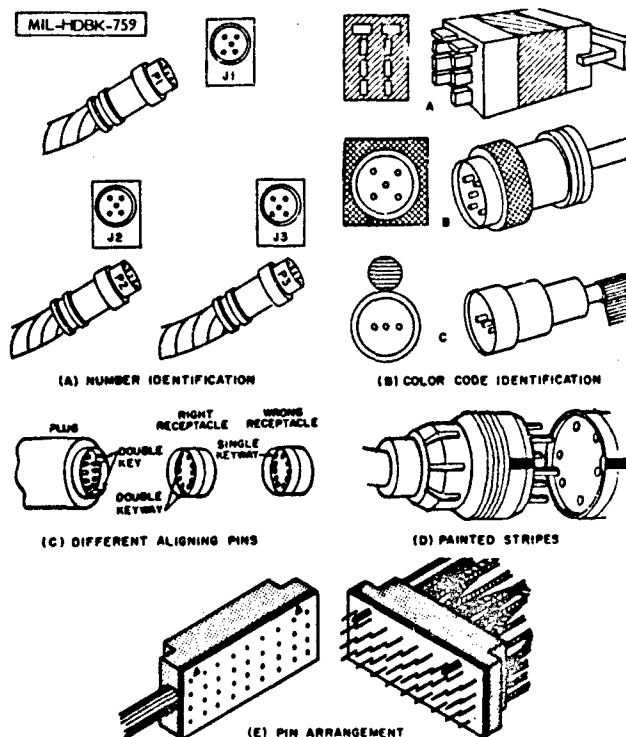


FIGURE 13.H.1 METHODS OF IDENTIFYING PLUGS AND RECEPTACLES



|  |                   |                                   |                                |                                |
|--|-------------------|-----------------------------------|--------------------------------|--------------------------------|
|  | Two-finger bar    | 26 4 8 30<br>(32) (64) (75)       | 15 30 30<br>(38) (75) (75)     | Not Applicable                 |
|  | One-hand bar      | 18 7 4 37 8 30<br>(41) (111) (75) | 20 50 40<br>(50) (125) (100)   | 30 5 25 60<br>(75) (125) (150) |
|  | Two-hand bar      | 18 7 8 6 40<br>(41) (215) (75)    | 20 105 40<br>(50) (125) (100)  | 30 110 60<br>(75) (125) (150)  |
|  | T-bar             | 15 40 30<br>(38) (100) (75)       | 20 45 40<br>(50) (115) (100)   | Not Applicable                 |
| MIL-STD-1472   |                   |                                   |                                |                                |
|  | J-bar             | 20 40 30<br>(50) (100) (75)       | 20 45 40<br>(50) (115) (100)   | 30 50 60<br>(75) (125) (150)   |
|  | Two-finger recess | 12 6 2 8 20<br>(32) (64) (50)     | 15 30 20<br>(38) (75) (50)     | Not Applicable                 |
|  | One-hand recess   | 20 4 25 35<br>(50) (110) (90)     | 35 5 25 40<br>(90) (135) (100) | 35 5 25 60<br>(90) (135) (125) |
|  | Finger tip recess | 0.75 - 0.5<br>(19) (13)           | 1.0 - 0.75<br>(25) (19)        | Not Applicable                 |
|  | One-finger recess | 1.25 - 2.0<br>(32) (50)           | 1.5 - 2.0<br>(38) (50)         | Not Applicable                 |
| Curvature of Handle or Edge<br>ROUNDS, NOT FACED, NOT 1ST OF OVAL HANDLES.<br>Weight of Item<br>Up to 15 lbs (up to 6.8 kg)<br>15 to 20 lbs (6.8 to 9.0 kg)<br>20 to 40 lbs (9.0 to 18 kg)<br>Over 40 lbs (over 18 kg)<br>Minimum Diameter<br>D: 1/4 in. (6 mm)<br>D: 1/2 in. (13 mm)<br>D: 3/4 in. (19 mm)<br>D: 1 in. (25 mm)<br>T: 1/2 in. (13 mm)<br>Gripping efficiency is best if finger can rest around handle or edge to any angle of 150 degrees or better. |                   |                                   |                                |                                |

FIGURE 14.B.1 MINIMUM HANDLE DIMENSIONS

|                  |               |
|------------------|---------------|
| 6 ft. (1,800 mm) | 29 lb (13 kg) |
| 5 ft. (1,500 mm) | 35 lb (16 kg) |
| 4 ft. (1,200 mm) | 50 lb (23 kg) |
| 3 ft. (900 mm)   | 65 lb (29 kg) |
| 2 ft. (600 mm)   | 80 lb (36 kg) |
| 1 ft. (300 mm)   | 85 lb (39 kg) |

FIGURE 14.C.1 DESIGN WEIGHT LIMITS

| HORIZONTAL FORCE AT LEAST    | APPLIED WITH*                          | CONDITION (μ COEFFICIENT OF FRICTION)  |
|------------------------------|--|--|
| 25 lb (108 N) PUSH OR PULL   | BOTH HANDS OR ONE SHOULDER OR THE BACK | WITH LOW TRACTION μ = 0.2  |
| 45 lb (200 N) PUSH OR PULL   | BOTH HANDS OR ONE SHOULDER OR THE BACK | WITH MEDIUM TRACTION μ = 0.3   |
| 15 lb (68 N) PUSH            | ONE HAND                               | IF BRACED AGAINST A VERTICAL WALL 20-40 in. (510-1015 mm) FROM AND PARALLEL TO THE PUSH PANEL  |
| 70 lb (308 N) PUSH OR PULL   | BOTH HANDS OR ONE SHOULDER OR THE BACK | WITH HIGH TRACTION μ > 0.9   |
| 110 lb (488 N) PUSH OR PULL  | BOTH HANDS OR ONE SHOULDER OR THE BACK | IF BRACED AGAINST A VERTICAL WALL 20-40 in. (510-1015 mm) FROM AND PARALLEL TO THE PANEL OR IF ANCHORING THE FEET ON A PERFECTLY NONSLIP GROUND (LINE A FOOTREST)      |
| 186 lb (836 N) THE BACK PUSH | THE BACK                               | IF BRACED AGAINST A VERTICAL WALL 23-43 in. (585-1093 mm) FROM AND PARALLEL TO THE PUSH PANEL OR IF ANCHORING THE FEET ON A PERFECTLY NONSLIP GROUND (LINE A FOOTREST) |

\* MAY BE DELETED FOR TWO AND TRIPLED FOR THREE OPERATORS PUSHING SIMULTANEOUSLY FOR THE FOURTH AND EACH ADDITIONAL OPERATOR NOT MORE THAN 75% OF THEIR PUSH CAPABILITY SHOULD BE ADDED

MIL-STD-14

FIGURE 14.C.2 HORIZONTAL PUSH AND PULL FORCES EXERTABLE (INTERMITTENTLY OR FOR SHORT PERIODS OF TIME)

# MINIMAL TWO HAND ACCESS OPENINGS WITHOUT VISUAL ACCESS

Reaching with both hands to depth of 150 to 490 mm:

|                  |        |                                   |
|------------------|--------|-----------------------------------|
| Light clothing:  | Width  | 200mm or the depth of reach*      |
|                  | Height | 125mm                             |
| Arctic clothing: | Width  | 150mm plus 3/4 the depth of reach |
|                  | Height | 180mm                             |

Reaching full arm's length (to shoulder) with both arms:

|        |       |
|--------|-------|
| Width  | 500mm |
| Height | 125mm |

Inserting bar grasped by handles on the front:

15mm clearance around bar, assuming adequate clearance around handles

Inserting bar with hands on the sides:

|                  |        |                           |
|------------------|--------|---------------------------|
| Light clothing:  | Width  | Box plus 115mm            |
|                  | Height | 12 mm or 15mm around box* |
| Arctic clothing: | Width  | Box plus 180mm            |
|                  | Height | 215mm or 15mm around box* |

\* Whichever is larger

11 hands full around bottom, allow an extra 20mm for light clothing, 25mm for arctic clothing

Reaching with both hands to depth of 8 to 18 inches:

|                  |        |                                |
|------------------|--------|--------------------------------|
| Light clothing:  | Width  | 8" or the depth of reach*      |
|                  | Height | 5"                             |
| Arctic clothing: | Width  | 6" plus 3/4 the depth of reach |
|                  | Height | 7"                             |

Reaching full arm's length (to shoulder) with both arms:

|        |         |
|--------|---------|
| Width  | 19 1/2" |
| Height | 5 1/2"  |

Inserting bar grasped by handles on the front:

1 1/2" clearance around bar, assuming adequate clearance around handles

Inserting bar with hands on the sides:

|                  |        |                            |
|------------------|--------|----------------------------|
| Light clothing:  | Width  | Box plus 4 1/2"            |
|                  | Height | 5" or 0.5" around box*     |
| Arctic clothing: | Width  | Box plus 7"                |
|                  | Height | 8 1/2" or 0.5" around box* |

\* Whichever is larger

11 hands full around bottom, allow an extra 1 1/2" for light clothing, 3" for arctic clothing

## MINIMAL ONE HAND ACCESS OPENINGS WITHOUT VISUAL ACCESS

Empty hand, to wrist:

|                    |               |              |
|--------------------|---------------|--------------|
| Bare hand, rolled: | 85mm          | sq or dia    |
| Bare hand, flat:   | 55mm x 100mm  | or 100mm dia |
| Glove or mitten:   | 100mm x 150mm | or 150mm dia |
| Arctic mitten:     | 125mm x 160mm | or 160mm dia |

Clenched hand, to wrist:

|                  |               |              |
|------------------|---------------|--------------|
| Bare hand:       | 90mm x 125mm  | or 125mm dia |
| Glove or mitten: | 115mm x 150mm | or 150mm dia |
| Arctic mitten:   | 180mm x 215mm | or 215mm dia |

Hand plus 1" dia object, to wrist:

|                  |       |           |
|------------------|-------|-----------|
| Bare hand:       | 95mm  | sq or dia |
| Glove or mitten: | 150mm | sq or dia |
| Arctic mitten:   | 180mm | sq or dia |

Hand plus object over 1" in dia, to wrist:

|                  |                              |
|------------------|------------------------------|
| Bare hand:       | 15mm clearance around object |
| Glove or mitten: | 40mm clearance around object |
| Arctic mitten:   | 90mm clearance around object |

Arm to elbow:

|                  |                     |
|------------------|---------------------|
| Light clothing:  | 100mm x 115mm       |
| Arctic clothing: | 180mm sq or dia     |
| With object:     | Clearances as above |

Arm to shoulder:

|                  |                     |           |
|------------------|---------------------|-----------|
| Light clothing:  | 125mm               | sq or dia |
| Arctic clothing: | 215mm               | sq or dia |
| With object:     | Clearances as above |           |

Empty hand, to wrist:

|                    |                 |               |
|--------------------|-----------------|---------------|
| Bare hand, rolled: | 3 3/8"          | sq or dia     |
| Bare hand, flat:   | 2 1/8" x 4 1/8" | or 4 1/8" dia |
| Glove or mitten:   | 4 1/8" x 6 1/8" | or 6 1/8" dia |
| Arctic mitten:     | 5 1/8" x 6 5/8" | or 6 5/8" dia |

Clenched hand, to wrist:

|                  |                 |               |
|------------------|-----------------|---------------|
| Bare hand:       | 3 5/8" x 5 1/8" | or 5 1/8" dia |
| Glove or mitten: | 4 5/8" x 6 1/8" | or 6 1/8" dia |
| Arctic mitten:   | 7 1/8" x 6 5/8" | or 6 5/8" dia |

Hand plus 1" dia object, to wrist:

|                  |        |           |
|------------------|--------|-----------|
| Bare hand:       | 3 7/8" | sq or dia |
| Glove or mitten: | 6 1/8" | sq or dia |
| Arctic mitten:   | 7 1/8" | sq or dia |

Hand plus object over 1" in dia, to wrist:

|                  |                                |
|------------------|--------------------------------|
| Bare hand:       | 1 7/8" clearance around object |
| Glove or mitten: | 2 5/8" clearance around object |
| Arctic mitten:   | 3 5/8" clearance around object |

Arm to elbow:

|                  |                     |               |
|------------------|---------------------|---------------|
| Light clothing:  | 4 1/8" x 4 5/8"     | or 4 5/8" dia |
| Arctic clothing: | 7 1/8" sq or dia    |               |
| With object:     | Clearances as above |               |

Arm to shoulder:

|                  |                     |           |
|------------------|---------------------|-----------|
| Light clothing:  | 5 1/8"              | sq or dia |
| Arctic clothing: | 8 1/8"              | sq or dia |
| With object:     | Clearances as above |           |

MIL-STD-1472

## MINIMAL FINGER ACCESS TO FIRST JOINT

Push button access:

|              |          |
|--------------|----------|
| Bare hand:   | 30mm dia |
| Gloved hand: | 40mm dia |

Two-finger twist access:

|              |                  |
|--------------|------------------|
| Bare hand:   | object plus 50mm |
| Gloved hand: | object plus 65mm |

Push button access:

|              |            |
|--------------|------------|
| Bare hand:   | 1 1/8" dia |
| Gloved hand: | 1 5/8" dia |

Two-finger twist access:

|              |                        |
|--------------|------------------------|
| Bare hand:   | object plus 2 1/8" dia |
| Gloved hand: | object plus 2 5/8" dia |

FIGURE 19.B.1 ARM AND HAND ACCESS DIMENSIONS

| MINIMUM DIMENSION, IN. | SQUARE | ROUND | RT*  |
|------------------------|--------|-------|------|
| HEAD BAND              | 6.0    | 6.0   | 6.0  |
| CHIN CLOTHES           | 6.0    | 6.0   | 6.0  |
| NECK HELMET            | 10.0   | 10.0  | 10.0 |

RECOMMENDED MINIMUM DIMENSIONS FOR HEAD ACCESS, 95TH PERCENT

| MINIMUM DIMENSION, IN. | SQUARE | ROUND | RT*  |
|------------------------|--------|-------|------|
| EMPTY HAND             | 4.0    | 4.0   | 4.0  |
| ARCTIC MITTEN          | 13.0   | 13.0  | 13.0 |

NOTE: OPTIONAL ON ALL CORNERS, MAX 1/4 IN. RADIUS

RECOMMENDED MINIMUM DIMENSIONS FOR HAND ACCESS, 95TH PERCENT

FIGURE



# **MAXIMUM WEIGHT OF ITEM**

9 lb (13 kg)  
6 lb (16 kg)  
0 lb (23 kg)  
5 lb (29 kg)  
0 lb (36 kg)  
5 lb (39 kg)

## **WEIGHT LIMITS**

CONDITION  
IN COEFFICIENT OF FRICTION

WITH LOW TRACTION  
0.05

WITH MEDIUM TRACTION  
0.15

BRACED AGAINST A VERTICAL WALL  
300 ± 10 (120 ± 4) mm FROM AND  
PARALLEL TO THE PUSH PANEL

WITH HIGH TRACTION  
0.30

BRACED AGAINST A VERTICAL WALL  
175 ± 10 (70 ± 4) mm FROM AND  
PARALLEL TO THE PANEL

ANCHORING THE FEET ON A  
PERFECTLY NONSLIP SURFACE (WHEELS &  
JOINTS)

BRACED AGAINST A VERTICAL WALL  
130 ± 10 (50 ± 4) mm FROM AND  
PARALLEL TO THE PANEL

ANCHORING THE FEET ON A  
PERFECTLY NONSLIP SURFACE (WHEELS &  
JOINTS)

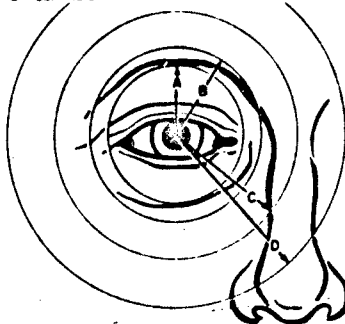
AS PUBLISHED, SUBJECT MUST BE  
175 CM (5' 9") OR TALLER

# **DESIGN WEIGHT LIMITS (MALE PERSONNEL)**

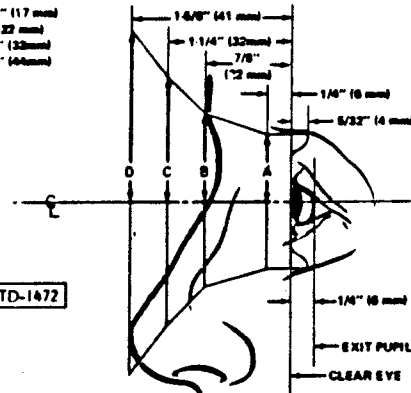
MIL-STD-1472

MIL-STD-1472

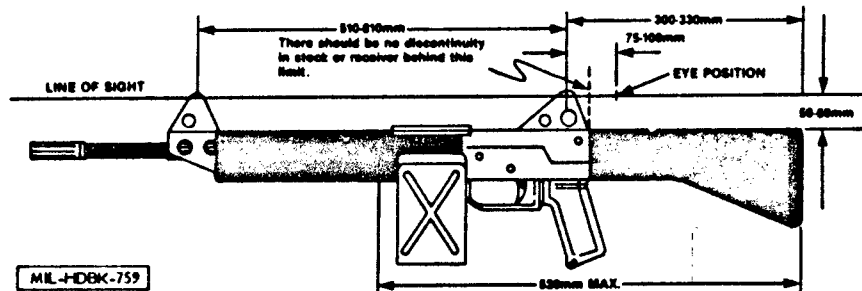
- A - SUPERCILIARY ARCH REQUIREMENT 11/16" (17 mm)
- B - NASAL BONE REQUIREMENT 7/8" (22 mm)
- C - GREATER ALAR CARTILAGE REQUIREMENT 1-1/4" (32 mm)
- D - ORBITAL CARTILAGE REQUIREMENT 1-3/4" (44 mm)



MIL-STD-1472



**FIGURE 15.B.1 ANATOMICAL LIMITS ON AXIALLY SYMMETRICAL OCULAR METAL PARTS**

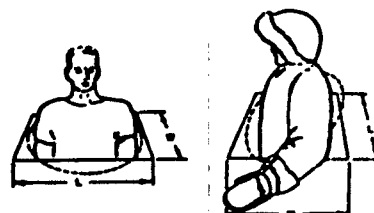
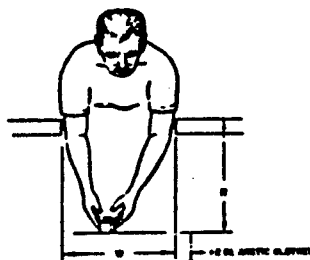


**FIGURE 16.B.1 RIFLES AND MACHINE GUN GUIDANCE DIMENSIONS**



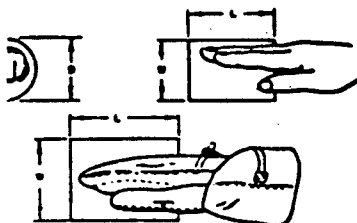
| Dimension       | Shoulder | Shoulder | Shoulder | Rectangular |
|-----------------|----------|----------|----------|-------------|
| Head width, in. | W        | L        | W        | L           |
| HEAD BREADTH    | 10.0     | 9.0      | 9.0      | 8.5         |
| HEAD DEPTH      | 10.0     | 9.0      | 9.0      | 8.5         |
| HEAD HEIGHT     | 10.0     | 9.0      | 9.0      | 8.5         |

**RECOMMENDED MINIMUM DIMENSIONS  
FOR HEAD ACCESS, 95TH PERCENTILE**



| Dimension       | Shoulder | Shoulder | Shoulder | Rectangular |
|-----------------|----------|----------|----------|-------------|
| Body width, in. | W        | L        | W        | L           |
| HEAD BREADTH    | 10.0     | 9.0      | 9.0      | 8.5         |
| HEAD DEPTH      | 10.0     | 9.0      | 9.0      | 8.5         |
| HEAD HEIGHT     | 10.0     | 9.0      | 9.0      | 8.5         |

**RECOMMENDED MINIMUM DIMENSIONS  
FOR BODY ACCESS, 95TH PERCENTILE**



| Dimension       | Shoulder | Shoulder | Shoulder | Rectangular |
|-----------------|----------|----------|----------|-------------|
| Hand width, in. | W        | L        | W        | L           |
| HEAD BREADTH    | 10.0     | 9.0      | 9.0      | 8.5         |
| HEAD DEPTH      | 10.0     | 9.0      | 9.0      | 8.5         |
| HEAD HEIGHT     | 10.0     | 9.0      | 9.0      | 8.5         |

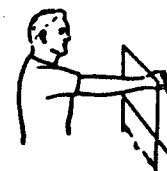
**RECOMMENDED MINIMUM DIMENSIONS  
FOR HAND ACCESS, 95TH PERCENTILE**



| Dimension       | Shoulder | Shoulder | Shoulder | Rectangular |
|-----------------|----------|----------|----------|-------------|
| Hand width, in. | W        | L        | W        | L           |
| HEAD BREADTH    | 10.0     | 9.0      | 9.0      | 8.5         |
| HEAD DEPTH      | 10.0     | 9.0      | 9.0      | 8.5         |
| HEAD HEIGHT     | 10.0     | 9.0      | 9.0      | 8.5         |

**RECOMMENDED MINIMUM DIMENSIONS  
FOR TWO HANDED ACCESS, 95TH PERCENTILE**

SAE J925



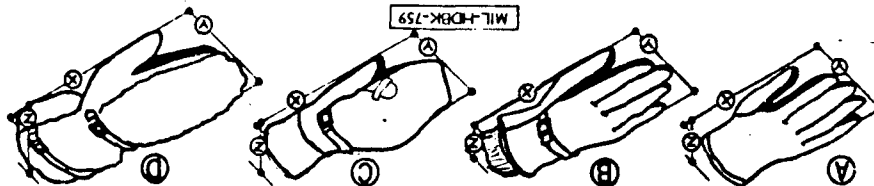
| Dimension      | Shoulder | Shoulder | Shoulder | Rectangular |
|----------------|----------|----------|----------|-------------|
| Arm width, in. | W        | L        | W        | L           |
| HEAD BREADTH   | 10.0     | 9.0      | 9.0      | 8.5         |
| HEAD DEPTH     | 10.0     | 9.0      | 9.0      | 8.5         |
| HEAD HEIGHT    | 10.0     | 9.0      | 9.0      | 8.5         |

**RECOMMENDED MINIMUM DIMENSIONS  
FOR ARM REACH ACCESS, 95TH PERCENTILE**

**FIGURE 19.B.2 MINIMUM ACCESS DIMENSIONS FOR CONSTRUCTION AND INDUSTRIAL MACHINERY**

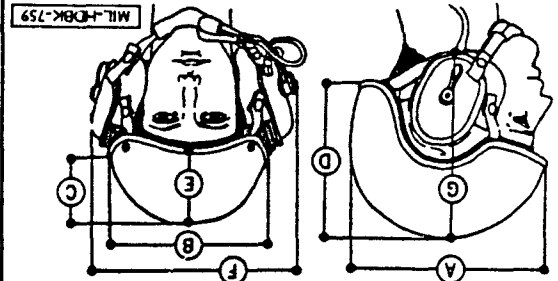


WILLIAM J. HODGES, JR.

[illegible]

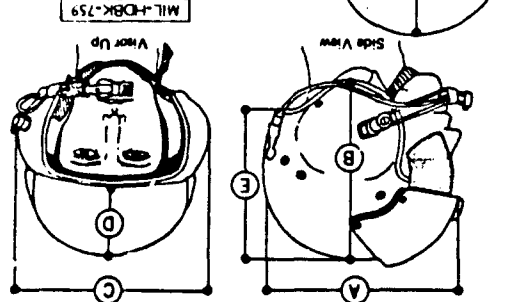
**CLONING**

| DIMENSION |                                  | SIZE |
|-----------|----------------------------------|------|
| A         | LENGTH OF HELMET                 | 205  |
| B         | HELMET BREADTH (EMT)             | 210  |
| C         | HEIGHT OF SHELL ABOVE EAR TO TOP | 210  |
| D         | HEIGHT BACK OF SHELL TO TOP      | 205  |
| E         | HEIGHT FRONT OF SHELL TO TOP     | 205  |
| F         | HELMET BREADTH                   | 205  |
| G         | HEIGHT FROM BOTTOM OF EAR TO TOP | 205  |



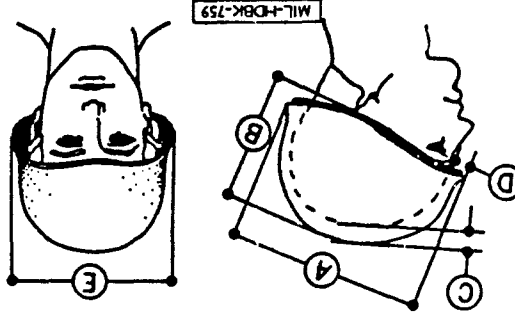
NO INDIA

| DUNSMITH                      |     |
|-------------------------------|-----|
| A. LENGTH OF HELMET           | 280 |
| B. HEIGHT OF HELMET BOWL      | 260 |
| C. HELMET BOWLINE             | 290 |
| B. HEIGHT FROM FRONT TO TOP   | 140 |
| F. HEIGHT FROM BACK TO TOP    | 140 |
| F. SUN SHIELD AT NOSE CURTAIN | 85  |



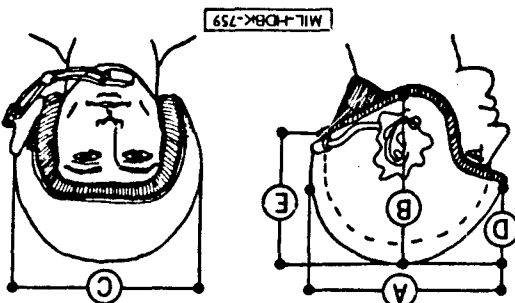
777

| DIMENSION |                               | SIZE (mm) |
|-----------|-------------------------------|-----------|
| A         | LENGTH, FRONT END TO REAR END | 3000      |
| B         | HEIGHT                        | 1700      |
| C         | TOP OF HEAD TO TOP OF HELMET  | 800       |
| D         | EYEBROW EDGE TO FRONT END     | 800       |
| E         | WIDTH, END TO END             | 2000      |

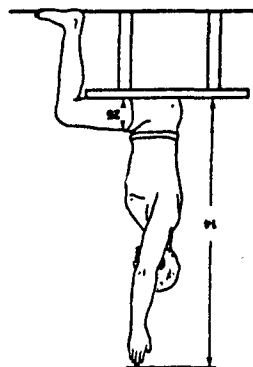
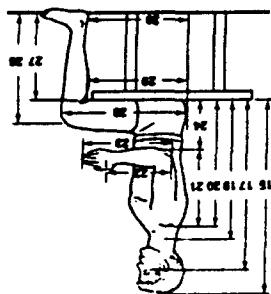


224

| DATE-TIME | 3.274 (min)                            |
|-----------|--|
| A         | LENGTH OF HELMET FRONT RIM TO REAR RIM |
| B         | HEIGHT FROM BACK TO TOP                |
| C         | HEIGHT FROM FRONT TO TOP               |
| D         | HEIGHT FROM EAR TO TOP                 |
| E         | BREADTH OF HELMET                      |







MIL-STD-1472 NATICK/TR-77/024

| PERCENTILE VALUES IN CENTIMETERS |      | PERCENTILE VALUES IN INCHES |      |
|----------------------------------|------|-----------------------------|------|
| 50th                             | 90th | 50th                        | 90th |
| 157                              | 171  | 62                          | 67   |
| 160                              | 174  | 63                          | 69   |
| 163                              | 177  | 64                          | 70   |
| 166                              | 180  | 65                          | 71   |
| 169                              | 183  | 66                          | 72   |
| 172                              | 186  | 67                          | 73   |
| 175                              | 189  | 68                          | 74   |
| 178                              | 192  | 69                          | 75   |
| 181                              | 195  | 70                          | 76   |
| 184                              | 198  | 71                          | 77   |
| 187                              | 201  | 72                          | 78   |
| 190                              | 204  | 73                          | 79   |
| 193                              | 207  | 74                          | 80   |
| 196                              | 210  | 75                          | 81   |
| 199                              | 213  | 76                          | 82   |
| 202                              | 216  | 77                          | 83   |
| 205                              | 219  | 78                          | 84   |
| 208                              | 222  | 79                          | 85   |
| 211                              | 225  | 80                          | 86   |
| 214                              | 228  | 81                          | 87   |
| 217                              | 231  | 82                          | 88   |
| 220                              | 234  | 83                          | 89   |
| 223                              | 237  | 84                          | 90   |
| 226                              | 240  | 85                          | 91   |
| 229                              | 243  | 86                          | 92   |
| 232                              | 246  | 87                          | 93   |
| 235                              | 249  | 88                          | 94   |
| 238                              | 252  | 89                          | 95   |
| 241                              | 255  | 90                          | 96   |
| 244                              | 258  | 91                          | 97   |
| 247                              | 261  | 92                          | 98   |
| 250                              | 264  | 93                          | 99   |
| 253                              | 267  | 94                          | 100  |
| 256                              | 270  | 95                          | 101  |
| 259                              | 273  | 96                          | 102  |
| 262                              | 276  | 97                          | 103  |
| 265                              | 279  | 98                          | 104  |
| 268                              | 282  | 99                          | 105  |
| 271                              | 285  | 100                         | 106  |
| 274                              | 288  | 101                         | 107  |
| 277                              | 291  | 102                         | 108  |
| 280                              | 294  | 103                         | 109  |
| 283                              | 297  | 104                         | 110  |
| 286                              | 300  | 105                         | 111  |
| 289                              | 303  | 106                         | 112  |
| 292                              | 306  | 107                         | 113  |
| 295                              | 309  | 108                         | 114  |
| 298                              | 312  | 109                         | 115  |
| 301                              | 315  | 110                         | 116  |
| 304                              | 318  | 111                         | 117  |
| 307                              | 321  | 112                         | 118  |
| 310                              | 324  | 113                         | 119  |
| 313                              | 327  | 114                         | 120  |
| 316                              | 330  | 115                         | 121  |
| 319                              | 333  | 116                         | 122  |
| 322                              | 336  | 117                         | 123  |
| 325                              | 339  | 118                         | 124  |
| 328                              | 342  | 119                         | 125  |
| 331                              | 345  | 120                         | 126  |
| 334                              | 348  | 121                         | 127  |
| 337                              | 351  | 122                         | 128  |
| 340                              | 354  | 123                         | 129  |
| 343                              | 357  | 124                         | 130  |
| 346                              | 360  | 125                         | 131  |
| 349                              | 363  | 126                         | 132  |
| 352                              | 366  | 127                         | 133  |
| 355                              | 369  | 128                         | 134  |
| 358                              | 372  | 129                         | 135  |
| 361                              | 375  | 130                         | 136  |
| 364                              | 378  | 131                         | 137  |
| 367                              | 381  | 132                         | 138  |
| 370                              | 384  | 133                         | 139  |
| 373                              | 387  | 134                         | 140  |
| 376                              | 390  | 135                         | 141  |
| 379                              | 393  | 136                         | 142  |
| 382                              | 396  | 137                         | 143  |
| 385                              | 399  | 138                         | 144  |
| 388                              | 402  | 139                         | 145  |
| 391                              | 405  | 140                         | 146  |
| 394                              | 408  | 141                         | 147  |
| 397                              | 411  | 142                         | 148  |
| 400                              | 414  | 143                         | 149  |
| 403                              | 417  | 144                         | 150  |
| 406                              | 420  | 145                         | 151  |
| 409                              | 423  | 146                         | 152  |
| 412                              | 426  | 147                         | 153  |
| 415                              | 429  | 148                         | 154  |
| 418                              | 432  | 149                         | 155  |
| 421                              | 435  | 150                         | 156  |
| 424                              | 438  | 151                         | 157  |
| 427                              | 441  | 152                         | 158  |
| 430                              | 444  | 153                         | 159  |
| 433                              | 447  | 154                         | 160  |
| 436                              | 450  | 155                         | 161  |
| 439                              | 453  | 156                         | 162  |
| 442                              | 456  | 157                         | 163  |
| 445                              | 459  | 158                         | 164  |
| 448                              | 462  | 159                         | 165  |
| 451                              | 465  | 160                         | 166  |
| 454                              | 468  | 161                         | 167  |
| 457                              | 471  | 162                         | 168  |
| 460                              | 474  | 163                         | 169  |
| 463                              | 477  | 164                         | 170  |
| 466                              | 480  | 165                         | 171  |
| 469                              | 483  | 166                         | 172  |
| 472                              | 486  | 167                         | 173  |
| 475                              | 489  | 168                         | 174  |
| 478                              | 492  | 169                         | 175  |
| 481                              | 495  | 170                         | 176  |
| 484                              | 498  | 171                         | 177  |
| 487                              | 501  | 172                         | 178  |
| 490                              | 504  | 173                         | 179  |
| 493                              | 507  | 174                         | 180  |
| 496                              | 510  | 175                         | 181  |
| 499                              | 513  | 176                         | 182  |
| 502                              | 516  | 177                         | 183  |
| 505                              | 519  | 178                         | 184  |
| 508                              | 522  | 179                         | 185  |
| 511                              | 525  | 180                         | 186  |
| 514                              | 528  | 181                         | 187  |
| 517                              | 531  | 182                         | 188  |
| 520                              | 534  | 183                         | 189  |
| 523                              | 537  | 184                         | 190  |
| 526                              | 540  | 185                         | 191  |
| 529                              | 543  | 186                         | 192  |
| 532                              | 546  | 187                         | 193  |
| 535                              | 549  | 188                         | 194  |
| 538                              | 552  | 189                         | 195  |
| 541                              | 555  | 190                         | 196  |
| 544                              | 558  | 191                         | 197  |
| 547                              | 561  | 192                         | 198  |
| 550                              | 564  | 193                         | 199  |
| 553                              | 567  | 194                         | 200  |
| 556                              | 570  | 195                         | 201  |
| 559                              | 573  | 196                         | 202  |
| 562                              | 576  | 197                         | 203  |
| 565                              | 579  | 198                         | 204  |
| 568                              | 582  | 199                         | 205  |
| 571                              | 585  | 200                         | 206  |
| 574                              | 588  | 201                         | 207  |
| 577                              | 591  | 202                         | 208  |
| 580                              | 594  | 203                         | 209  |
| 583                              | 597  | 204                         | 210  |
| 586                              | 600  | 205                         | 211  |
| 589                              | 603  | 206                         | 212  |
| 592                              | 606  | 207                         | 213  |
| 595                              | 609  | 208                         | 214  |
| 598                              | 612  | 209                         | 215  |
| 601                              | 615  | 210                         | 216  |
| 604                              | 618  | 211                         | 217  |
| 607                              | 621  | 212                         | 218  |
| 610                              | 624  | 213                         | 219  |
| 613                              | 627  | 214                         | 220  |
| 616                              | 630  | 215                         | 221  |
| 619                              | 633  | 216                         | 222  |
| 622                              | 636  | 217                         | 223  |
| 625                              | 639  | 218                         | 224  |
| 628                              | 642  | 219                         | 225  |
| 631                              | 645  | 220                         | 226  |
| 634                              | 648  | 221                         | 227  |
| 637                              | 651  | 222                         | 228  |
| 640                              | 654  | 223                         | 229  |
| 643                              | 657  | 224                         | 230  |
| 646                              | 660  | 225                         | 231  |
| 649                              | 663  | 226                         | 232  |
| 652                              | 666  | 227                         | 233  |
| 655                              | 669  | 228                         | 234  |
| 658                              | 672  | 229                         | 235  |
| 661                              | 675  | 230                         | 236  |
| 664                              | 678  | 231                         | 237  |
| 667                              | 681  | 232                         | 238  |
| 670                              | 684  | 233                         | 239  |
| 673                              | 687  | 234                         | 240  |
| 676                              | 690  | 235                         | 241  |
| 679                              | 693  | 236                         | 242  |
| 682                              | 696  | 237                         | 243  |
| 685                              | 699  | 238                         | 244  |
| 688                              | 702  | 239                         | 245  |
| 691                              | 705  | 240                         | 246  |
| 694                              | 708  | 241                         | 247  |
| 697                              | 711  | 242                         | 248  |
| 700                              | 714  | 243                         | 249  |
| 703                              | 717  | 244                         | 250  |
| 706                              | 720  | 245                         | 251  |
| 709                              | 723  | 246                         | 252  |
| 712                              | 726  | 247                         | 253  |
| 715                              | 729  | 248                         | 254  |
| 718                              | 732  | 249                         | 255  |
| 721                              | 735  | 250                         | 256  |
| 724                              | 738  | 251                         | 257  |
| 727                              | 741  | 252                         | 258  |
| 730                              | 744  | 253                         | 259  |
| 733                              | 747  | 254                         | 260  |
| 736                              | 750  | 255                         | 261  |
| 739                              | 753  | 256                         | 262  |
| 742                              | 756  | 257                         | 263  |
| 745                              | 759  | 258                         | 264  |
| 748                              | 762  | 259                         | 265  |
| 751                              | 765  | 260                         | 266  |
| 754                              | 768  | 261                         | 267  |
| 757                              | 771  | 262                         | 268  |
| 760                              | 774  | 263                         | 269  |
| 763                              | 777  | 264                         | 270  |
| 766                              | 780  | 265                         | 271  |
| 769                              | 783  | 266                         | 272  |
| 772                              | 786  | 267                         | 273  |
| 775                              | 789  | 268                         | 274  |
| 778                              | 792  | 269                         | 275  |
| 781                              | 795  | 270                         | 276  |
| 784                              | 798  | 271                         | 277  |
| 787                              | 801  | 272                         | 278  |
| 790                              | 804  | 273                         | 279  |
| 793                              | 807  | 274                         | 280  |
| 796                              | 810  | 275                         | 281  |
| 799                              | 813  | 276                         | 282  |
| 802                              | 816  | 277                         | 283  |
| 805                              | 819  | 278                         | 284  |
| 808                              | 822  | 279                         | 285  |
| 811                              | 825  | 280                         | 286  |
| 814                              | 828  | 281                         | 287  |
| 817                              | 831  | 282                         | 288  |
| 820                              | 834  | 283                         | 289  |
| 823                              | 837  | 284                         | 290  |
| 826                              | 840  | 285                         | 291  |
| 829                              | 843  | 286                         | 292  |
| 832                              | 846  | 287                         | 293  |
| 835                              | 849  | 288                         | 294  |
| 838                              | 852  | 289                         | 295  |
| 841                              | 855  | 290                         | 296  |
| 844                              | 858  | 291                         | 297  |
| 847                              | 861  | 292                         | 298  |
| 850                              | 864  | 293                         | 299  |
| 853                              | 867  | 294                         | 300  |
| 856                              | 870  | 295                         | 301  |
| 859                              | 873  | 296                         | 302  |
| 862                              | 876  | 297                         | 303  |
| 865                              | 879  | 298                         | 304  |
| 868                              | 882  | 299                         | 305  |
| 871                              | 885  | 300                         | 306  |
| 874                              | 888  | 301                         | 307  |
| 877                              | 891  | 302                         | 308  |
| 880                              | 894  | 303                         | 309  |
| 883                              | 897  | 304                         | 310  |
| 886                              | 900  | 305                         | 311  |
| 889                              | 903  | 306                         | 312  |
| 892                              | 906  | 307                         | 313  |
| 895                              | 909  | 308                         | 314  |
| 898                              | 912  | 309                         | 315  |
| 901                              | 915  | 310                         | 316  |
| 904                              | 918  | 311                         | 317  |
| 907                              | 921  | 312                         | 318  |
| 910                              | 924  | 313                         | 319  |
| 913                              | 927  | 314                         | 320  |
| 916                              | 930  | 315                         | 321  |
| 919                              | 933  | 316                         | 322  |
| 922                              | 936  | 317                         | 323  |
| 925                              | 939  | 318                         | 324  |
| 928                              | 942  | 319                         | 325  |
| 931                              | 945  | 320                         | 326  |
| 934                              | 948  | 321                         | 327  |
| 937                              | 951  | 322                         | 328  |
| 940                              | 954  | 323                         | 329  |
| 943                              | 957  | 324                         | 330  |
| 946                              | 960  | 325                         | 331  |
| 949                              | 963  | 326                         | 332  |
| 952                              | 966  | 327                         | 333  |
| 955                              | 969  | 328                         | 334  |
| 958                              | 972  | 329                         | 335  |
| 961                              | 975  | 330                         | 336  |
| 964                              | 978  | 331                         | 337  |
| 967                              | 981  | 332                         | 338  |
| 970                              | 984  | 333                         | 339  |
| 973                              | 987  | 334                         | 340  |
| 976                              | 990  | 335                         | 341  |
| 979                              | 993  | 336                         | 342  |
| 982                              | 996  | 337                         | 343  |
| 985                              | 999  | 338                         | 344  |
| 988                              | 1002 | 339                         | 345  |
| 991                              | 1005 | 340                         | 346  |
| 994                              | 1008 | 341                         | 347  |
| 997                              | 1011 | 342                         | 348  |
| 1000                             | 1014 | 343                         | 349  |

FIGURE 25. B. 1 STANDING BODY DIMENSIONS

| PERCENTILE VALUES IN CENTIMETERS |  |  |  | 50th PERCENTILE |  |  |  | 90th PERCENTILE |  |  |  |
|----------------------------------|--|--|--|-----------------|--|--|--|-----------------|--|--|--|
|                                  |  |  |  | GROUND TROOPS   |  |  |  | GROUND TROOPS   |  |  |  |
|                                  |  |  |  | AVIATORS        |  |  |  | AVIATORS        |  |  |  |
|                                  |  |  |  | WOMEN           |  |  |  | WOMEN           |  |  |  |
|                                  |  |  |  | 162.0           |  |  |  | 162.0           |  |  |  |
|                                  |  |  |  | 151.1           |  |  |  | 151.1           |  |  |  |
|                                  |  |  |  | 142.2           |  |  |  | 142.2           |  |  |  |
|                                  |  |  |  | 133.0           |  |  |  | 133.0           |  |  |  |
|                                  |  |  |  | 123.0           |  |  |  | 123.0           |  |  |  |
|                                  |  |  |  | 108.0           |  |  |  | 108.0           |  |  |  |
|                                  |  |  |  | 98.0            |  |  |  | 98.0            |  |  |  |
|                                  |  |  |  | 82.1            |  |  |  | 82.1            |  |  |  |
|                                  |  |  |  | 73.5            |  |  |  | 73.5            |  |  |  |
|                                  |  |  |  | 62.3            |  |  |  | 62.3            |  |  |  |
|                                  |  |  |  | 50.0            |  |  |  | 50.0            |  |  |  |
|                                  |  |  |  | 40.0            |  |  |  | 40.0            |  |  |  |
|                                  |  |  |  | 30.0            |  |  |  | 30.0            |  |  |  |
|                                  |  |  |  | 20.0            |  |  |  | 20.0            |  |  |  |
|                                  |  |  |  | 10.0            |  |  |  | 10.0            |  |  |  |
|                                  |  |  |  | 5.0             |  |  |  | 5.0             |  |  |  |
|                                  |  |  |  | 2.5             |  |  |  | 2.5             |  |  |  |
|                                  |  |  |  | 1.0             |  |  |  | 1.0             |  |  |  |
|                                  |  |  |  | 0.5             |  |  |  | 0.5             |  |  |  |
|                                  |  |  |  | 0.2             |  |  |  | 0.2             |  |  |  |
|                                  |  |  |  | 0.1             |  |  |  | 0.1             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |
|                                  |  |  |  | 0.0             |  |  |  | 0.0             |  |  |  |



FIGURE 25. B.3 DEPTH AND BREADTH DIMENSIONS

| PERCENTILE VALUES IN CENTIMETERS |          |       |       | 50th PERCENTILE |          |       |       |
|----------------------------------|----------|-------|-------|-----------------|----------|-------|-------|
| GROUND                           | AVIATORS | WOMEN | MOOPS | GROUND          | AVIATORS | MOOPS | WOMEN |
| 22 CHEST DEPTH                   | 18.9     | 20.4  | 20.7  | 27.8            | 27.8     | 27.8  | 27.2  |
| 23 BUTTOK DEPTH                  | 27.3     | 29.1  | 28.4  | 27.4            | 27.4     | 27.4  | 27.4  |
| 24 CHEST BREADTH                 | 20.2     | 21.7  | 21.5  | 26.7            | 26.7     | 26.7  | 26.7  |
| 25 SHOULDER BREADTH              | 41.5     | 43.2  | 43.2  | 49.8            | 49.8     | 49.8  | 49.8  |
| 26 FOREARM BREADTH               | 36.8     | 43.2  | 43.2  | 40.7            | 40.7     | 40.7  | 40.7  |
| 27 HIP BREADTH                   | 30.8     | 33.0  | 33.0  | 33.6            | 33.6     | 33.6  | 33.6  |
| 28 KNEE BREADTH                  | 44.8     | 46.7  | 46.7  | 42.4            | 42.4     | 42.4  | 42.4  |
| 29 ANKLE BREADTH                 | 19.1     | 19.1  | 19.1  | 25.5            | 25.5     | 25.5  | 25.5  |
| 30 HIPS TO KNEE BREADTH          | 10.7     | 10.7  | 10.7  | 10.7            | 10.7     | 10.7  | 10.7  |
| 31 CHEST DEPTH                   | 10.8     | 11.8  | 11.8  | 10.8            | 10.8     | 10.8  | 10.8  |
| 32 CHEST BREADTH                 | 15.9     | 17.0  | 17.0  | 15.9            | 15.9     | 15.9  | 15.9  |
| 33 FOREARM BREADTH               | 18.3     | 19.0  | 19.0  | 18.3            | 18.3     | 18.3  | 18.3  |
| 34 HIP BREADTH                   | 12.7     | 13.1  | 13.1  | 12.7            | 12.7     | 12.7  | 12.7  |
| 35 KNEE BREADTH                  | 15.7     | 16.0  | 16.0  | 15.7            | 15.7     | 15.7  | 15.7  |
| 36 HIPS TO KNEE BREADTH          | 10.7     | 10.7  | 10.7  | 10.7            | 10.7     | 10.7  | 10.7  |

FIGURE 25. B.4 CIRCUMFERENCE AND SURFACE DIMENSIONS

| PERCENTILE VALUES IN INCHES     |          |       |       | 50th PERCENTILE |          |       |       |
|---------------------------------|----------|-------|-------|-----------------|----------|-------|-------|
| GROUND                          | AVIATORS | WOMEN | MOOPS | GROUND          | AVIATORS | WOMEN | MOOPS |
| 22 CHEST DEPTH                  | 7.4      | 8.0   | 8.2   | 11.0            | 11.0     | 11.0  | 11.0  |
| 23 BUTTOK DEPTH                 | 10.8     | 11.8  | 11.8  | 10.8            | 10.8     | 10.8  | 10.8  |
| 24 CHEST BREADTH                | 15.9     | 17.0  | 17.0  | 15.9            | 15.9     | 15.9  | 15.9  |
| 25 SHOULDER BREADTH             | 16.5     | 17.0  | 17.0  | 16.5            | 16.5     | 16.5  | 16.5  |
| 26 FOREARM BREADTH              | 18.3     | 19.0  | 19.0  | 18.3            | 18.3     | 18.3  | 18.3  |
| 27 HIP BREADTH                  | 12.7     | 13.1  | 13.1  | 12.7            | 12.7     | 12.7  | 12.7  |
| 28 KNEE BREADTH                 | 15.7     | 16.0  | 16.0  | 15.7            | 15.7     | 15.7  | 15.7  |
| 29 ANKLE BREADTH                | 7.8      | 7.8   | 7.8   | 10.3            | 10.3     | 10.3  | 10.3  |
| 30 HIPS TO KNEE BREADTH         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 31 CHEST DEPTH                  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 32 CHEST BREADTH                | 6.3      | 6.3   | 6.3   | 6.3             | 6.3      | 6.3   | 6.3   |
| 33 FOREARM BREADTH              | 7.3      | 7.3   | 7.3   | 7.3             | 7.3      | 7.3   | 7.3   |
| 34 HIP BREADTH                  | 5.0      | 5.0   | 5.0   | 5.0             | 5.0      | 5.0   | 5.0   |
| 35 KNEE BREADTH                 | 6.3      | 6.3   | 6.3   | 6.3             | 6.3      | 6.3   | 6.3   |
| 36 HIPS TO KNEE BREADTH         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 37 FOREARM BREADTH              | 7.3      | 7.3   | 7.3   | 7.3             | 7.3      | 7.3   | 7.3   |
| 38 KNEE BREADTH                 | 6.3      | 6.3   | 6.3   | 6.3             | 6.3      | 6.3   | 6.3   |
| 39 ANKLE BREADTH                | 3.1      | 3.1   | 3.1   | 4.1             | 4.1      | 4.1   | 4.1   |
| 40 HIPS TO ANKLE BREADTH        | 1.0      | 1.0   | 1.0   | 1.0             | 1.0      | 1.0   | 1.0   |
| 41 CHEST CIRCUMFERENCE          | 28.7     | 29.1  | 29.1  | 28.7            | 28.7     | 28.7  | 28.7  |
| 42 CHEST CIRCUMFERENCE          | 30.8     | 31.7  | 31.7  | 30.8            | 30.8     | 30.8  | 30.8  |
| 43 BUTTOK CIRCUMFERENCE         | 33.0     | 33.6  | 33.6  | 33.0            | 33.0     | 33.0  | 33.0  |
| 44 CHEST BUST CIRCUMFERENCE     | 33.0     | 33.6  | 33.6  | 33.0            | 33.0     | 33.0  | 33.0  |
| 45 WAIST CIRCUMFERENCE          | 28.7     | 29.1  | 29.1  | 28.7            | 28.7     | 28.7  | 28.7  |
| 46 HIPS CIRCUMFERENCE           | 33.0     | 33.6  | 33.6  | 33.0            | 33.0     | 33.0  | 33.0  |
| 47 KNEE CIRCUMFERENCE           | 19.1     | 19.1  | 19.1  | 25.5            | 25.5     | 25.5  | 25.5  |
| 48 ANKLE CIRCUMFERENCE          | 7.8      | 7.8   | 7.8   | 10.3            | 10.3     | 10.3  | 10.3  |
| 49 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 50 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 51 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 52 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 53 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 54 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 55 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 56 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 57 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 58 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 59 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 60 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 61 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 62 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 63 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 64 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 65 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 66 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 67 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 68 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 69 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 70 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 71 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 72 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 73 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 74 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 75 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 76 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 77 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 78 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 79 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 80 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 81 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 82 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 83 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 84 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 85 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 86 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 87 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 88 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 89 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 90 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 91 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 92 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 93 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 94 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 95 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 96 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 97 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 98 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 99 HIPS TO ANKLE CIRCUMFERENCE  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 100 HIPS TO ANKLE CIRCUMFERENCE | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |

FIGURE 25. B.5 HAND DIMENSIONS

| PERCENTILE VALUES IN INCHES     |          |       |       | 50th PERCENTILE |          |       |       |
|---------------------------------|----------|-------|-------|-----------------|----------|-------|-------|
| GROUND                          | AVIATORS | WOMEN | MOOPS | GROUND          | AVIATORS | WOMEN | MOOPS |
| 1 HAND LENGTH                   | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 2 HAND BREADTH                  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 3 HAND CIRCUMFERENCE            | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 4 INDEX FINGER LENGTH           | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 5 INDEX FINGER BREADTH          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 6 INDEX FINGER CIRCUMFERENCE    | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 7 MIDDLE FINGER LENGTH          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 8 MIDDLE FINGER BREADTH         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 9 MIDDLE FINGER CIRCUMFERENCE   | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 10 RING FINGER LENGTH           | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 11 RING FINGER BREADTH          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 12 RING FINGER CIRCUMFERENCE    | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 13 PINKY FINGER LENGTH          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 14 PINKY FINGER BREADTH         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 15 PINKY FINGER CIRCUMFERENCE   | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 16 PALM LENGTH                  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 17 PALM BREADTH                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 18 PALM CIRCUMFERENCE           | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 19 Wrist Length                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 20 Wrist Breadth                | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 21 Wrist Circumference          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 22 Forearm Length               | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 23 Forearm Breadth              | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 24 Forearm Circumference        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 25 Hand Length                  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 26 Hand Breadth                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 27 Hand Circumference           | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 28 Index Finger Length          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 29 Index Finger Breadth         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 30 Index Finger Circumference   | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 31 Middle Finger Length         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 32 Middle Finger Breadth        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 33 Middle Finger Circumference  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 34 Ring Finger Length           | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 35 Ring Finger Breadth          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 36 Ring Finger Circumference    | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 37 Pinky Finger Length          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 38 Pinky Finger Breadth         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 39 Pinky Finger Circumference   | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 40 Palm Length                  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 41 Palm Breadth                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 42 Palm Circumference           | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 43 Wrist Length                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 44 Wrist Breadth                | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 45 Wrist Circumference          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 46 Forearm Length               | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 47 Forearm Breadth              | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 48 Forearm Circumference        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 49 Hand Length                  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 50 Hand Breadth                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 51 Hand Circumference           | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 52 Index Finger Length          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 53 Index Finger Breadth         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 54 Index Finger Circumference   | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 55 Middle Finger Length         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 56 Middle Finger Breadth        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 57 Middle Finger Circumference  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 58 Ring Finger Length           | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 59 Ring Finger Breadth          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 60 Ring Finger Circumference    | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 61 Pinky Finger Length          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 62 Pinky Finger Breadth         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 63 Pinky Finger Circumference   | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 64 Palm Length                  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 65 Palm Breadth                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 66 Palm Circumference           | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 67 Wrist Length                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 68 Wrist Breadth                | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 69 Wrist Circumference          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 70 Forearm Length               | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 71 Forearm Breadth              | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 72 Forearm Circumference        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 73 Hand Length                  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 74 Hand Breadth                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 75 Hand Circumference           | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 76 Index Finger Length          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 77 Index Finger Breadth         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 78 Index Finger Circumference   | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 79 Middle Finger Length         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 80 Middle Finger Breadth        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 81 Middle Finger Circumference  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 82 Ring Finger Length           | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 83 Ring Finger Breadth          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 84 Ring Finger Circumference    | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 85 Pinky Finger Length          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 86 Pinky Finger Breadth         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 87 Pinky Finger Circumference   | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 88 Palm Length                  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 89 Palm Breadth                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 90 Palm Circumference           | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 91 Wrist Length                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 92 Wrist Breadth                | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 93 Wrist Circumference          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 94 Forearm Length               | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 95 Forearm Breadth              | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 96 Forearm Circumference        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 97 Hand Length                  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 98 Hand Breadth                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 99 Hand Circumference           | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 100 Index Finger Length         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 101 Index Finger Breadth        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 102 Index Finger Circumference  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 103 Middle Finger Length        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 104 Middle Finger Breadth       | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 105 Middle Finger Circumference | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 106 Ring Finger Length          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 107 Ring Finger Breadth         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 108 Ring Finger Circumference   | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 109 Pinky Finger Length         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 110 Pinky Finger Breadth        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 111 Pinky Finger Circumference  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 112 Palm Length                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 113 Palm Breadth                | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 114 Palm Circumference          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 115 Wrist Length                | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 116 Wrist Breadth               | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 117 Wrist Circumference         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 118 Forearm Length              | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 119 Forearm Breadth             | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 120 Forearm Circumference       | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 121 Hand Length                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 122 Hand Breadth                | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 123 Hand Circumference          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 124 Index Finger Length         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 125 Index Finger Breadth        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 126 Index Finger Circumference  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 127 Middle Finger Length        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 128 Middle Finger Breadth       | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 129 Middle Finger Circumference | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 130 Ring Finger Length          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 131 Ring Finger Breadth         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 132 Ring Finger Circumference   | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 133 Pinky Finger Length         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 134 Pinky Finger Breadth        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 135 Pinky Finger Circumference  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 136 Palm Length                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 137 Palm Breadth                | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 138 Palm Circumference          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 139 Wrist Length                | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 140 Wrist Breadth               | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 141 Wrist Circumference         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 142 Forearm Length              | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 143 Forearm Breadth             | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 144 Forearm Circumference       | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 145 Hand Length                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 146 Hand Breadth                | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 147 Hand Circumference          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 148 Index Finger Length         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 149 Index Finger Breadth        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 150 Index Finger Circumference  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 151 Middle Finger Length        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 152 Middle Finger Breadth       | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 153 Middle Finger Circumference | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 154 Ring Finger Length          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 155 Ring Finger Breadth         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 156 Ring Finger Circumference   | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 157 Pinky Finger Length         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 158 Pinky Finger Breadth        | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 159 Pinky Finger Circumference  | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 160 Palm Length                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 161 Palm Breadth                | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 162 Palm Circumference          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 163 Wrist Length                | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 164 Wrist Breadth               | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 165 Wrist Circumference         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 166 Forearm Length              | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 167 Forearm Breadth             | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 168 Forearm Circumference       | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 169 Hand Length                 | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 170 Hand Breadth                | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 171 Hand Circumference          | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4.3   |
| 172 Index Finger Length         | 4.3      | 4.3   | 4.3   | 4.3             | 4.3      | 4.3   | 4     |



FIGURE 25 B 5 KRAM AND FOOT DIMENSIONS

| PERCENTILE VALUES IN CENTIMETERS |          |        |       | PERCENTILE VALUES IN INCHES |          |        |       |
|----------------------------------|----------|--------|-------|-----------------------------|----------|--------|-------|
| 50th PERCENTILE                  |          |        |       | 50th PERCENTILE             |          |        |       |
| GROUND                           | AVIATORS | TROOPS | WOMEN | GROUND                      | AVIATORS | TROOPS | WOMEN |
| 57 HAND LENGTH                   | 17.4     | 17.7   | 18.1  | 20.7                        | 19.1     | 20.7   | 20.0  |
| 58 PALM LENGTH                   | 9.6      | 10.0   | 9.8   | 9.7                         | 10.0     | 9.7    | 9.5   |
| 59 HAND BREADTH                  | 8.1      | 8.2    | 8.0   | 8.0                         | 8.1      | 8.0    | 7.9   |
| 60 HAND CIRCUMFERENCE            | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 61 HAND THICKNESS                | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 62 FOOT LENGTH                   | 24.5     | 24.6   | 24.6  | 27.5                        | 26.0     | 27.5   | 26.5  |
| 63 INSTEP LENGTH                 | 17.7     | 17.5   | 18.3  | 21.7                        | 21.0     | 21.7   | 21.0  |
| 64 FOOT BREADTH                  | 9.0      | 9.0    | 9.0   | 9.0                         | 9.0      | 9.0    | 9.0   |
| 65 FOOT CIRCUMFERENCE            | 22.5     | 22.6   | 22.6  | 27.0                        | 26.3     | 27.0   | 26.5  |
| 66 HEEL ANGLE                    | 31.3     | 30.7   | 30.5  | 37.0                        | 36.3     | 37.0   | 36.5  |
| CIRCUMFERENCE                    |          |        |       | CIRCUMFERENCE               |          |        |       |
| 67 FOOT CIRCUMFERENCE            | 22.5     | 22.6   | 22.6  | 27.0                        | 26.3     | 27.0   | 26.5  |
| 68 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 69 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 70 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 71 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 72 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 73 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 74 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 75 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 76 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 77 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 78 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 79 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 80 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 81 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 82 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 83 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 84 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 85 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 86 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 87 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 88 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 89 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 90 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 91 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 92 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 93 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 94 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 95 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 96 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 97 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 98 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 99 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 100 ANKLE THICKNESS              | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |

MIL-STD-1472 NATICK/TR-77/024

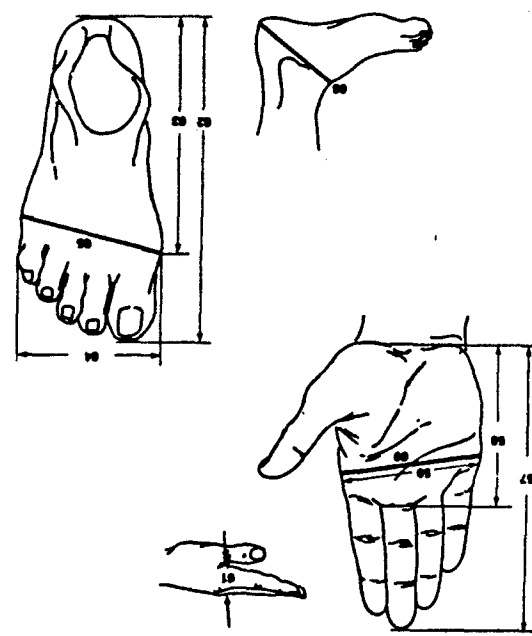
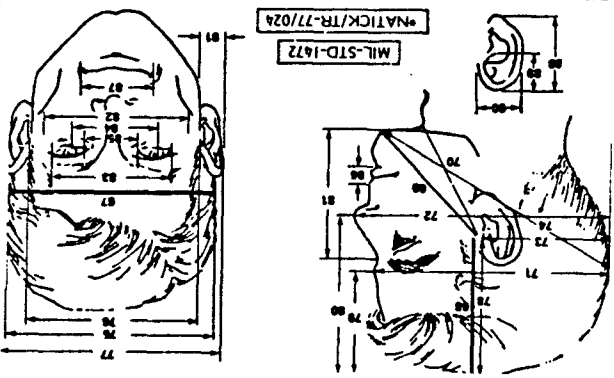


FIGURE 25 B 6 HEAD AND FACE DIMENSIONS

| PERCENTILE VALUES IN CENTIMETERS |          |        |       | PERCENTILE VALUES IN INCHES |          |        |       |
|----------------------------------|----------|--------|-------|-----------------------------|----------|--------|-------|
| 50th PERCENTILE                  |          |        |       | 50th PERCENTILE             |          |        |       |
| GROUND                           | AVIATORS | TROOPS | WOMEN | GROUND                      | AVIATORS | TROOPS | WOMEN |
| 57 HEAD LENGTH                   | 17.4     | 17.7   | 18.1  | 20.7                        | 19.1     | 20.7   | 20.0  |
| 58 PALM LENGTH                   | 9.6      | 10.0   | 9.8   | 9.7                         | 10.0     | 9.7    | 9.5   |
| 59 HAND BREADTH                  | 8.1      | 8.2    | 8.0   | 8.0                         | 8.1      | 8.0    | 7.9   |
| 60 HAND CIRCUMFERENCE            | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 61 HAND THICKNESS                | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 62 FOOT LENGTH                   | 24.5     | 24.6   | 24.6  | 27.5                        | 26.0     | 27.5   | 26.5  |
| 63 INSTEP LENGTH                 | 17.7     | 17.5   | 18.3  | 21.7                        | 21.0     | 21.7   | 21.0  |
| 64 FOOT BREADTH                  | 9.0      | 9.0    | 9.0   | 9.0                         | 9.0      | 9.0    | 9.0   |
| 65 FOOT CIRCUMFERENCE            | 22.5     | 22.6   | 22.6  | 27.0                        | 26.3     | 27.0   | 26.5  |
| 66 HEEL ANGLE                    | 31.3     | 30.7   | 30.5  | 37.0                        | 36.3     | 37.0   | 36.5  |
| CIRCUMFERENCE                    |          |        |       | CIRCUMFERENCE               |          |        |       |
| 67 FOOT CIRCUMFERENCE            | 22.5     | 22.6   | 22.6  | 27.0                        | 26.3     | 27.0   | 26.5  |
| 68 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 69 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 70 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 71 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 72 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 73 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 74 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 75 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 76 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 77 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 78 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 79 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 80 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 81 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 82 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 83 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 84 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 85 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 86 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 87 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 88 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 89 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 90 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 91 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 92 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 93 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 94 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 95 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 96 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 97 ANKLE THICKNESS               | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 98 ANKLE CIRCUMFERENCE           | 19.5     | 19.6   | 19.6  | 22.1                        | 20.8     | 22.1   | 20.5  |
| 99 ANKLE BREADTH                 | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |
| 100 ANKLE THICKNESS              | 4.1      | 4.2    | 4.1   | 4.1                         | 4.2      | 4.1    | 4.0   |

MIL-STD-1472 NATICK/TR-77/024



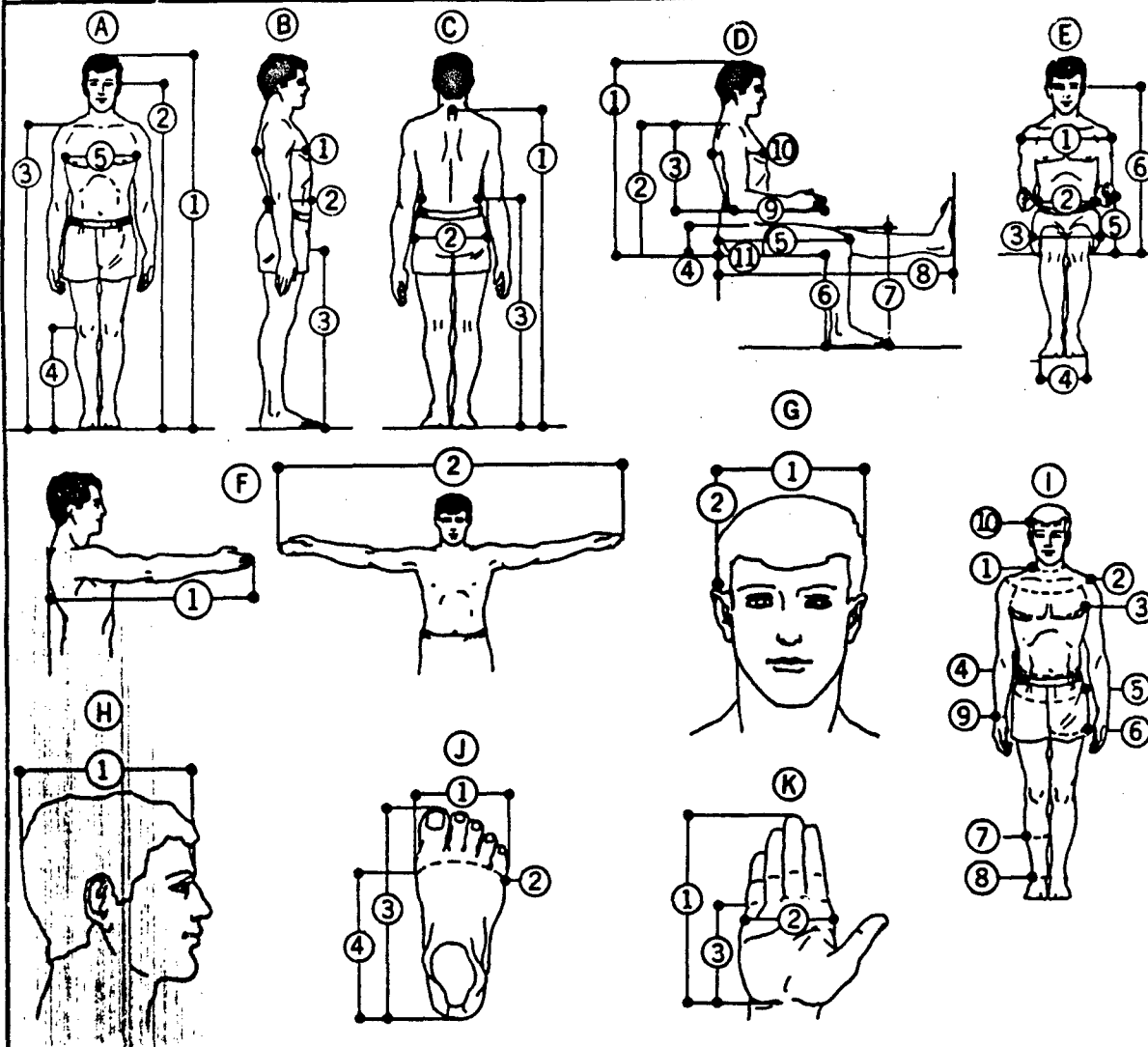


|                                  | BASIC UNIFORM   |       | ADDITIONS TO THE BASIC UNIFORM |       |                                    |       |  |       |
|----------------------------------|---|-------|--------------------------------|-------|------------------------------------|-------|--|-------|
|                                  | UNDERWEAR<br>KHAKIS, OR O.D.'S<br>OR FATIGUES,<br>SOCKS, SHOES,<br>HELMET & LINER |       | BLOUSE OR FIELD<br>JACKET      |       | BLOUSE OR FIELD<br>JACKET OVERCOAT |       | COMBAT SUIT<br>OVERCOAT,<br>GLOVES, WOOL CAP<br>& COMBAT BOOTS |       |
| WEIGHT (kg)                      | 5th   | 95th  | 5th                            | 95th  | 5th                                | 95th  | 5th  | 95th  |
| BODY DIMENSIONS (mm)             | 52.3  | 101.0 | 53.4                           | 102.9 | 65.5                               | 108.0 | 66.9   | 108.4 |
| A-1 STATURE                      | 170.0   | 182.3 | 169.0                          | 182.3 | 169.0                              | 182.3 | 167.0  | 182.5 |
| D-1 SITTING HEIGHT               | 87.1  | 100.3 | 87.4                           | 100.5 | 87.9                               | 100.6 | 86.1   | 101.1 |
| E-1 EYE HEIGHT, SITTING          | 71.9  | 84.3  | 72.1                           | 84.6  | 72.4                               | 84.8  | 72.0   | 86.1  |
| D-2 MID-SHOULDER HEIGHT, SITTING | 66.0  | 83.5  | 67.0                           | 84.6  | 66.9                               | 84.4  | 65.0   | 83.0  |
| D-7 KNEE HEIGHT, SITTING         | 52.0  | 62.3  | 52.0                           | 62.3  | 52.1                               | 62.3  | 52.1   | 62.2  |
| D-5 BUTTOCK-KNEE LENGTH          | 56.1  | 67.0  | 56.3                           | 67.3  | 56.5                               | 67.5  | 56.1   | 68.0  |
| D-3 SHOULDER-ELBOW LENGTH        | 34.3  | 40.0  | 36.3                           | 41.7  | 36.3                               | 42.7  | 36.3   | 42.7  |
| E-1 SHOULDER BREADTH             | 42.7  | 51.4  | 44.5                           | 53.3  | 46.0                               | 54.0  | 46.0   | 54.0  |
| A-5 CHEST BREADTH                | 29.5  | 36.0  | 29.7                           | 36.8  | 29.3                               | 36.3  | 29.7   | 36.0  |
| E-2 FOREARM-FOREARM BREADTH      | 41.4  | 52.2  | 42.7                           | 54.2  | 44.7                               | 56.3  | 45.5   | 51.0  |
| C-2 HIP BREADTH                  | 31.0  | 38.0  | 31.3                           | 38.4  | 30.2                               | 40.1  | 34.0   | 40.0  |
| E-3 HIP BREADTH, SITTING         | 32.3  | 40.0  | 32.0                           | 41.4  | 33.0                               | 42.2  | 34.5   | 42.0  |
| B-1 CHEST DEPTH                  | 21.0  | 22.0  | 22.1                           | 23.0  | 25.4                               | 32.5  | 26.4   | 32.5  |
| J-3 FOOT LENGTH                  | 27.7  | 32.0  | 27.7                           | 32.0  | 27.7                               | 32.5  | 27.3   | 34.5  |
| J-1 FOOT BREADTH                 | 10.7  | 11.0  | 10.3                           | 11.0  | 10.2                               | 11.0  | 12.2   | 13.7  |

HAND LENGTH (See Figure 25 B.5 for 95th percentile)  
HAND BREADTH (See Figure 25 B.5 for 95th percentile)

MIL-HDBK-759

FIGURE 25. B.7 CLOTHED BODY DIMENSIONS OF THE 5th AND 95th PERCENTILE SOLDIER



- A. 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- B. 1.
- 2.
- 3.
- C. 1.
- 2.
- 3.
- D. 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- E. 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- F. 1.
- 2.
- G. 1.
- 2.
- H. 1.
- I. 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- J. 1.
- 2.
- 3.
- K. 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.
- 11.
- 12.
- 13.
- 14.
- 15.
- 16.
- 17.
- 18.
- 19.
- 20.
- 21.
- 22.
- 23.
- 24.
- 25.
- 26.
- 27.
- 28.
- 29.
- 30.
- 31.
- 32.
- 33.
- 34.
- 35.
- 36.
- 37.
- 38.
- 39.
- 40.
- 41.
- 42.
- 43.
- 44.
- 45.
- 46.
- 47.
- 48.
- 49.
- 50.
- 51.
- 52.
- 53.
- 54.
- 55.
- 56.
- 57.
- 58.
- 59.
- 60.
- 61.
- 62.
- 63.
- 64.
- 65.
- 66.
- 67.
- 68.
- 69.
- 70.
- 71.
- 72.
- 73.
- 74.
- 75.
- 76.
- 77.
- 78.
- 79.
- 80.
- 81.
- 82.
- 83.
- 84.
- 85.
- 86.
- 87.
- 88.
- 89.
- 90.
- 91.
- 92.
- 93.
- 94.
- 95.
- 96.
- 97.
- 98.
- 99.
- 100.



BASIC COMPONENTS OF COLD-DRY UNIFORM  
(ARCTIC CLOTHED)Undershirt, Men's, 50 Cotton/50 Wool, Full  
SleeveDrawers, Men's, 50 Cotton/50 Wool, Ankle Length  
Socks, Men's, Wool Cushion Sole, OG 408, Stretch  
Type

Suspenders, Trousers, Scissors Back Type

Shirt, Men's, Wool Nylon Flannel, OG 108

Liner, Trousers, Nylon Quilted, 6.2 oz., OG 106

Trousers, Men's, Cotton Nylon, Wind Resistant Sateen,  
8.5 oz., OG 107

Liner, Coat, Men's, Nylon Quilted, 6.2 oz., OG 106

Coat, Men's, Cotton and Nylon, Wind Resistant Sateen,  
8.5 oz., OG 107

Liner, Parka, Men's, Nylon Quilted, 6.2 oz., OG 106

Parka, Men's Cotton and Nylon Oxford, OG 107, without  
Hood

Liner, Trousers, Nylon Quilted, Natural

Trousers, Camouflage, Cotton/Nylon, Water Repellent,  
WhiteCap, Insulating, Helmet Liner, Cotton Nylon Oxford,  
OG 107Hood, Winter, Cotton and Nylon Oxford, OG 107, with  
Draw Cord and Fur Ruff

Glove Inserts, Wool and Nylon Knit, OG 108

Glove Shells, Leather, Black

Mitten Inserts, Wool and Nylon Knit, OG, Trigger Finger

Mitten Shells, Trigger Finger, Leather Palm and Thumb

Mitten Set, Arctic, Gauntlet Style Shell with Leather  
PalmBoot, Insulated, Cold Weather, Men's, Rubber, White,  
with Release Valve

Trousers, Camouflage, White

Parka, Camouflage, White

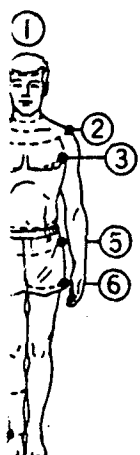
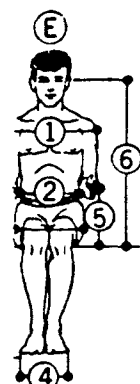
Mitten Shells, Cotton White

| TABLE 25. BODY DIMENSIONS, INCLUDING ARCTIC CLOTHING <sup>1</sup> |          |                |           |                |
|---|----------|----------------|-----------|----------------|
| PERCENTILE IN CENTIMETERS   |          |                |           |                |
|   | 5th NUDE | ARCTIC CLOTHED | 50th NUDE | ARCTIC CLOTHED |
| STANDING  |          |                |           |                |
| WEIGHT (kg)   | 57.3     | 90             | 91.8      | 106.1          |
| A. 1. STATURE   |          |                |           |                |
|   | 163.8    | 171.4          | 166.0     | 182.5          |
| 2. EYE HEIGHT   | 152.1    | 158.9          | 172.9     | 175.8          |
| 3. SHOULDER HEIGHT  | 133.6    | 138.0          | 154.2     | 158.0          |
| 4. KNEECAP HEIGHT   | 47.7     | 51.3           | 58.5      | 63.0           |
| 5. CHEST BREADTH  | 27.4     | 46.8           | 34.3      | 46.8           |
| B. 1. CHEST DEPTH   |          |                |           |                |
|   | 20.0     | 30.0           | 26.7      | 32.0           |
| 2. WAIST DEPTH  | 18.0     | 25.0           | 24.0      | 35.5           |
| 3. CROTCH HEIGHT  | 76.0     | 71.8           | 92.0      | 83.0           |
| C. 1. CERVICAL HEIGHT   |          |                |           |                |
|   | 130.2    | 148.0          | 160.0     | 163.5          |
| 2. HIP BREADTH  | 30.2     | 39.5           | 37.0      | 46.2           |
| 3. WAIST HEIGHT   | 97.8     | 103.0          | 115.3     | 118.8          |
| SEATED  |          |                |           |                |
| D. 1. SITTING HEIGHT  |          |                |           |                |
|   | 84.6     | 88.0           | 87.0      | 101.5          |
| 2. MID SHOULDER HEIGHT  | 57.2     | 58.5           | 67.8      | 68.3           |
| 3. SHOULDER ELBOW HEIGHT  | 33.7     | 37.3           | 40.0      | 42.0           |
| 4. THIGH CLEARANCE HEIGHT   | 12.2     | 16.5           | 17.0      | 19.0           |
| 5. BUTTOCK-KNEE LENGTH  | 54.8     | 60.0           | 64.3      | 67.3           |
| 6. BACK OF KNEE HEIGHT<br>(POPULITEAL HEIGHT)                     | 46.5     | 46.0           | 50.0      | 48.5           |
| 7. KNEE HEIGHT  | 40.5     | 46.4           | 50.6      | 64.0           |
| 8. BUTTOCK-LEG LENGTH   | 100.0    | 109.0          | 117.0     | 125.0          |
| 9. ELBOW-FINGERTIP HEIGHT   | 44.2     | 54.4           | 51.8      | 54.8           |
| 10. CHEST DEPTH   | 20.0     | 33.3           | 26.7      | 34.8           |
| 11. BUTTOCK-POPULITEAL LENGTH                                     | 46.0     | 43.7           | 54.8      | 52.0           |
| E. 1. SHOULDER BREADTH  |          |                |           |                |
|   | 41.4     | 47.5           | 48.5      | 56.0           |
| 2. MAXIMUM FOREARM<br>FOREARM BREADTH                             | 38.0     | 46.5           | 43.6      | 70.6           |
| 3. HIP BREADTH, SITTING   | 30.7     | 41.1           | 38.4      | 46.0           |
| 4. BREADTH OF BOTH FEET   | 19.3     | 26.6           | 21.6      | 28.4           |
| 5. ELBOW REST HEIGHT  | 17.5     | 18.3           | 28.0      | 27.2           |
| 6. EYE HEIGHT   | 72.8     | 74.7           | 84.6      | 86.8           |
| F. 1. FUNCTIONAL REACH<br>FROM WALL                               |          |                |           |                |
|   | 72.6     | 77.7           | 90.9      | 96.5           |
| 2. SPAN   | 106.1    | 177.7          | 191.0     | 194.6          |
| G. 1. HEAD BREADTH  |          |                |           |                |
|   | 14.4     | 23.0           | 16.3      | 23.0           |
| 2. HEAD   | 11.9     | 16.5           | 14.5      | 20.0           |
| H. 1. HEAD LENGTH   |          |                |           |                |
|   | 18.3     | 27.7           | 26.7      | 27.7           |
| I. BODY CIRCUMFERENCES  |          |                |           |                |
| 1. NECK   | 34.3     | 60.6           | 41.0      | 66.3           |
| 2. SHOULDER   | 105.5    | 131.0          | 124.2     | 151.5          |
| 3. CHEST  | 84.0     | 106.5          | 100.0     | 129.3          |
| 4. WAIST  | 70.0     | 97.3           | 86.0      | 127.0          |
| 5. HIP  | 86.0     | 117.5          | 105.7     | 141.2          |
| 6. UPPER THIGH  | 46.0     | 81.2           | 63.8      | 77.8           |
| 7. CALF   | 32.5     | 58.0           | 41.5      | 66.0           |
| 8. ANKLE  | 20.5     | 36.5           | 25.0      | 46.7           |
| 9. WRIST  | 15.7     | 31.0           | 18.5      | 32.5           |
| 10. HEAD  | 53.6     | 91.5           | 64.6      | 91.5           |
| J. FOOT   |          |                |           |                |
| 1. BALL OF FOOT BREADTH   | 9.0      | 12.2           | 10.8      | 13.5           |
| 2. BALL OF FOOT<br>CIRCUMFERENCE                                  | 22.5     | 37.0           | 27.5      | 46.5           |
| 3. FOOT LENGTH  | 24.7     | 32.3           | 29.0      | 34.0           |
| 4. BALL OF FOOT LENGTH  | 18.0     | 21.8           | 21.5      | 23.0           |
| K. HAND   |          |                |           |                |
| 1. HAND LENGTH  | 17.5     | 28.0           | 20.7      | 24.0           |
| 2. HAND BREADTH AT<br>METACARP                                    | 8.3      | 12.7           | 9.7       | 12.2           |
| 3. PALM LENGTH  | 9.5      | 16.5           | 11.7      | 12.4           |

<sup>1</sup> BASED ON U.S. ARMY MEN, 1966

MIL-HDBK-759

FIGURE 25. B. 8 NUDE AND ARCTIC CLOTHED BODY DIMENSIONS



| LOAD   | APPROXIMATE WEIGHT |        |
|--|--------------------|--------|
|  | KILOGRAMS          | POUNDS |
| FIGHTING LOAD                                  |                    |        |
| CLOTHING                                       |                    |        |
| PARKY HELMET                                   | 1.36               | 3.00   |
| BATTLE CLOTHES UNIFORM                         | 1.73               | 3.81   |
| PARKY HELMET                                   | 1.36               | 3.00   |
| UNDERWEAR CLOTHING AND SOCKS                   | 0.27               | 0.60   |
| BELT HANGING WITH ATTACHABLE                   | 0.68               | 1.50   |
| BOOTS LEATHER 2000                             | 1.10               | 2.42   |
|  | 6.53               | 14.37  |
| EQUIPMENT                                      |                    |        |
| RIFLE M16 7.62 mm MAGAZINE AND SLING           | 2.50               | 5.50   |
| AMMUNITION POUCHES 12 500 GR BULLETS IN 6      |                    |        |
| MAGAZINES                                      | 2.21               | 4.87   |
| WATER CANNES 2.00                              | 0.91               | 2.00   |
| LAND 2 IN OFF ROAD 1.00                        | 1.00               | 2.20   |
| CARTON 1/2 GAL FUEL AND COVER                  | 1.51               | 3.33   |
| CARTON 1/2 GAL FUEL AND COVER                  | 1.51               | 3.33   |
| WATER PURIFICATION TABLETS                     | 0.03               | 0.06   |
| INDIVIDUAL EQUIPMENT BELT FIRST AID PACK 1     | 0.72               | 1.59   |
| WATER AND SUPPLIES                             | 1.10               | 2.42   |
| HYDRATING TOOL WATER                           | 0.50               | 1.10   |
| BATTERY 1 BY 4000000                           | 0.27               | 0.60   |
| WATER 1 BY 4000000                             | 0.27               | 0.60   |
| PONCHO   | 10.25              | 22.57  |
| EXISTENCE LOAD                                 |                    |        |
| ALICE PACK BULLETS 4000000                     | 1.12               | 2.46   |
| CHEMICAL PROTECTIVE OVERSUIT AND GLOVES        | 2.64               | 5.81   |
| AND BOOTS                                      | 0.90               | 1.97   |
| CAP M100                                       | 0.50               | 1.10   |
| UNDERWEAR AND SOCKS 2.00                       | 0.91               | 2.00   |
| HYDRATING TOOL WATER                           | 1.10               | 2.42   |
| BATTERY 1 BY 4000000                           | 0.27               | 0.60   |
| WATER 1 BY 4000000                             | 0.27               | 0.60   |
| JACKET FIELD 1 BY 4000000 LEATHER 1 BY 4000000 | 1.50               | 3.30   |
| WATER 1 BY 4000000                             | 0.27               | 0.60   |
| SAG WATERPROOF 1.00                            | 0.45               | 0.99   |
|  | 16.17              | 35.39  |

TYPICAL FIGHTING AND EXISTENCE LOADS (TENTH OF TONS)

MIL-STD-1472

FIGURE 28. B. 1 TEMPERATURE ZONE (HOT WEATHER)  
FIGHTING AND EXISTENCE LOAD ITEMS (TYPICAL)